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Forthcoming Events.

FEBRUARY 19.

Swansea Technical College Metallurgical Society:—General meeting at Swansea. "Some Notes on the Hot Rolling of Blackplates," Paper by J. Mort.

Staffordshire Iron and Steel Institute:—Joint meeting with Institute of Metals and the Birmingham Metallurgical Society at Dudley. "Blast Furnace Practice," Paper by R. S. Bethell.

FEBRUARY 21-MARCH 4.

British Industries Fair.
Institute of British Foundrymen.

FEBRUARY 19.

Falkirk Section:—Ordinary meeting. "The Relationship of Temperature and Structure in Cast Iron," Paper by R. Hay, B.Sc.

Newcastle-on-Tyne (Junior Section):—Ordinary meeting "Some Causes of Failures in Iron and Steel," Paper by F. C. Spencer.

Wales and Monmouth Branch:—Ordinary meeting at Cardiff. "Semi Steel," Paper by J. E. Hurst.

Lancashire Branch (Junior Section):—Ordinary meeting at Manchester. "Pattern Making in Plaster of Paris," Paper by C. Heggie.

London Junior Section:—A visit to the Ealing Park Foundry. Will be followed by an address by A. R. Bartlett, "Repeat Job in the Foundry and Some Ways of Handling It."

FEBRUARY 25.

Institution of Production Engineers:—General meeting in London. "The Production of Cylinder Blocks in Quantities of 25, 250 and 2,500 per Week," Paper by H. Mantell.

THE FOUNDRY TRADE JOURNAL IS THE OFFICIAL ORGAN OF THE INSTITUTE OF BRITISH FOUNDRYMEN; THE WELSH ENGINEERS' AND FOUNDERS' ASSOCIATION, AND THE FOUNDRY TRADES EQUIPMENT AND SUPPLIES ASSOCIATION.

Institute of British Foundrymen.
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Secretary: F. J. Griffiths, 20, Fisher Street, Swansea.

Foundry Trades Equipment & Supplies Association.
Secretary: K. S. Bridges, Avenue Chambers, Southampton Row, London, W.C.1.

Twenty-Five Years Ago.

This year is the 25th anniversary of the establishment of THE FOUNDRY TRADE JOURNAL, and in this connection Mr. F. J. Cook's Paper, printed elsewhere in this issue, is most interesting.

It is customary on such occasions to point out the wonderful progress that has been made, but we confess that the only real change is a phenomenal expansion in the knowledge of metallurgy and the development of mechanical moulding. A quarter of a century ago a few erudite individuals were calculating their cupola charges on a chemical composition basis; several makes of moulding machines were in use; pneumatic tools and liquid-fuel furnaces were described in our first issue. Apparently even then the apprenticeship problem was just as pressing, as the then Editor stated: "There are some firms who are pursuing a more intelligent and considerate policy with their apprentices. We know of one, and no doubt there are several others that encourage their apprentices to take a course in mechanical drawing and metallurgy." This phrase might well have been written to-day. We rather envy our predecessor in one respect. In his second issue, February, 1902, he said that no less than six new foundries were being put into action in the Manchester area. The Planet Foundry, at Audenshaw; Jones & Company, Limited, for sewing machine castings; the National Gas Engine Company, Limited, Ashton-under-Lyne; Craven Brothers, Limited, Manchester; Holden & Brookes, Limited, of Manchester; and the Unbreakable Pulley and Mill Gearing Company, Limited, Manchester.

The first microphotograph appeared in 1903. It is often thought that the Institute of British Foundrymen devotes too much of its time to the academic side of the foundry work, it being forgotten that at its first conference the initial lecture was by Dr. Percy Longmuir on "The Microscope in the Foundry."

To be quite candid the foundry trade has not made the progress it ought. The photographs of the foundries of Alfred Herbert, and Vickers at Barrow, taken in 1901, are more modern than some quite large ones to be found to-day.

We feel much more sure of the next 25 years, because there is a better realisation of the importance of internal transport, and what is more important, the industry is gradually crystallising out into one concrete entity. In 1902 there merely existed the trade unions and a few employers' federations. To-day there are the Institute of British Foundrymen, the British Cast Iron Research Association, the National Light Castings Association, the National Ironfoundry Employers' Federation, and a number of active district associations, which in their councils treat with a wide range of subjects.

Another factor destined to bring out improvements in the condition of this complex industry is the earnest attention which is being given to adequate costing methods. There has been in the past the pious hope that if each moulder turned out 2 cwts. per day of castings the foundry was making profits.

XUM

The British Industries Fair.

Foundrymen who propose to visit the Birmingham Section of the British Industries Fair, to be held at Castle Bromwich, from February 21 to March 4, will find quite a large number of stands specially devoted to their interests. Primarily, **Pneulec, Limited**, of Mafeking Road, Smethwick, near Birmingham, are showing for the first time in Great Britain the Pneulec-Royer sand-mixing machine. This machine receives the sand in a hopper, disintegrates it, and expels it from the machine at high speed by means of a specially designed belt studded with steel springs. The action of these studs effectively separates the grains of the sand, which is thrown forward in a stream through a steel comb.

A second exhibit of a novel character is a tensile testing machine designed by Mr. F. J. Cook and Mr. G. B. Richards. It is hydraulically operated, using mineral oil, and is so designed that side-strain is eliminated.

The Monometer Manufacturing Company (1918), Limited, of Savoy House, 115, Strand, London, W.C.2, are showing plant of direct interest to our non-ferrous readers. It includes die-casting machinery for aluminium alloys, white metals, and lead-base alloys. A tilting furnace capable of melting iron, steel, copper, and brass alloys by means of oil, gas and coke fuel is one of the latest productions. Heat treatment plant is also demonstrated.

W. Canning & Company, Limited, of 133, Great Hampton Street, Birmingham, have as their main exhibit an automatic electro-plating apparatus, but many of their auxiliary exhibits are well known and appreciated in the dressing shops in British foundries, especially their grinding machinery.

Automatic and Electric Furnaces, Limited, of 173, Farringdon Road, London, E.C.1, are showing a range of electric heated and automatically controlled furnaces for hardening, annealing, and tempering, and we suggest that the enamelling muffles should be of exceptional interest to some of the light casting founders.

Vono Company, of Duport Foundry, Tipton, is a foundry catering for foundries, inasmuch as it makes vices of a special character; many varieties of these are being shown.

Rapid Magnetting Machine Company, Limited, of 52, Lombard Street, Birmingham, are showing machines of vital interest to foundries, both ferrous and non-ferrous. The elimination of iron from sand and non-ferrous scrap has been studied by this firm, and the information they possess should be of real interest to all founders.

Gibbons Bros., Limited, of Dudley, specialising as they do in furnace construction and furnace charging machines, this well-known firm's exhibit appeals to a wide range of foundries, especially those making light castings, such as baths, etc., which require hot enamelling.

Davidson & Company, Limited, of Sirocco Works, Belfast, appeal to the foundry industry with fans for blowing cupolas and ventilating casting shops. Few foundries have solved all their ventilation and dust-removal problems, and an examination of Sirocco products can usefully be included in any survey of the subject.

Wadkin & Company, Limited, of Leicester, are showing a full range of pattern-shop machinery. They were one of the few British firms which exhibited at the Detroit Exhibition, and their products were much appreciated by the Americans. Duplicate machines are being exhibited at Castle Bromwich, and a visit will add interest to the description which we recently published.

T. J. Priestman, Leopold Street, Birmingham.—This firm is showing a complete range of non-ferrous alloys for preparing and compounding of mixtures for castings. The service this firm affords enables the founder to eliminate much of the guesswork normally associated with brass-founding.

Allen Liversedge & Company, Limited, Victoria Station House, London, S.W.—This exhibit causes the founder sad reflections mingled with hopes, as he will have demonstrated to him the possibility of reclaiming what would otherwise be waster castings. Such progress is being made that the welding of cast iron is now within the range of possibilities, and in this connection the acetylene method is particularly promising. It is well established for steel and other alloys, and the technique for cast iron is being rapidly developed.

There is an exceptionally large number of foundries showing their products. Electricity is represented by the **General Electric Company**, the **Metropolitan Vickers** and the **British Thomson-Houston**.

W. & T. Avery are showing a wide range of weighing machines. The light casting trade is represented by the **Well Fire and Foundry Company**; **William Green & Company, Limited**, of Ecclesfield; **N. Cockburn & Company, Limited**, of Falkirk; **McDowell & Company, Limited**, of Falkirk; the **Falkirk Iron Company, Limited**; and the **Coalbrookdale Company**. Malleable castings are being shown by **Thos. Hale**, of Tipton. Pumps, gas and oil engines and heavy machinery by **G. & J. Weir**, of Glasgow; **Ruston & Hornsby**, of Lincoln; **Vickers, Petters**, of Ipswich; **Petters, Limited**, of Yeovil; **Marshall, Sons & Company**, of Gainsborough; **Tangyes**, of Birmingham, and **Joshua Buckton & Company, Limited**, of Leeds.

It will thus be realised that a visit by foundrymen to Castle Bromwich is thoroughly worth while.

Institute of British Foundrymen.

Sheffield Conference, 1927.

It is expected that the following Papers will be submitted to the Annual Meeting, to be held in Sheffield from July 5 to July 8:—

(1) "Importance of Air Control in Efficient Cupola Practice," by Mr. P. H. Wilson, of Stanton.
(2) "The Properties of Coke Affecting Cupola Melting of Steel," by J. T. MacKenzie, Birmingham, U.S.A. (American Exchange Paper.)
(3) "The Influence of Chromium and Nickel on High Quality and Heat Treated Cast Iron," by Professor Piwowaisky.
(4) "High Test Cast Iron," by Mr. F. M. Robbins.
(5) "The Influence of Chromium and Nickel on British and American Cast Irons," by Mr. T. H. Turner and Dr. A. B. Everest.
(6) "The Strength of Cast Iron," by Mr. J. E. Fletcher.
(7) "The Manufacture of a Large Steel Casting," by Mr. F. A. Melmoth and Mr. T. Brown.
(8) "Strains in Non-Ferrous Castings," by Dr. Desch.
(9) "Malleable Cast Iron," by Mr. E. R. T. Taylor. (From the British Cast Iron Research Association.)
(10) Subject not known, by M. Audo. (French Exchange Paper.)
(11) Belgian Exchange Paper.

The Presidential Address will be given by Mr. J. T. Goodwin (Sheepbridge).

Foundry Query.

Legal Aspect of Wasters.

It is stated that about 15 years ago we published a report of a case where a foundry supplied an engineer with some non-ferrous castings, which on machining proved defective through porosity. The engineers claimed for cost of machining, retaining the swarf, whilst returning to the founder the machined defective casting, demanding a new casting. The decision of the Court is thought to be that the liability of the founder was limited to the supply of a fresh casting, and that he was entitled to receive back the defective casting, plus the swarf. If the reference can be given it will be appreciated by L. C. R.

MR. W. T. EVANS and Mr. A. E. Peace, respectively foundry manager and metallurgist to Messrs. Leys Malleable Foundry Company, Limited, of Derby, are shortly leaving, visiting the United States of America on a short tour of inspection.

Correspondence.

[We accept no responsibility for the statements made or the opinions expressed by our correspondents.]

Alloyed Cast Iron.

To the Editor of THE FOUNDRY TRADE JOURNAL.

SIR,—The able and most interesting article on "Alloy Cast Irons," from the pen of Mr. T. H. Turner, printed in the two latest issues of your journal, brings into the forefront of attention a question of great moment to the ironfounding industry, and I venture to write in its appreciation and the hope of obtaining some further enlightenment in this matter. In your issue of January 20, p. 59, second col. near bottom, Mr. Turner says that "chromium increases total carbon content," does he mean that the carbon in ferro-chrome, when this is used, passes into the metal, or is he pointing out that a chromium-bearing iron absorbs more carbon in passing through the cupola than does a "straight" iron? This question is important as affecting the alternative use of cupolas or reverberatory furnaces.

Machinable hardness is an important and fascinating question. Mr. Turner's remarks would seem to show that an addition of nickel to an iron more graphite is thrown out than formerly, but that this graphite is more nodulised and finely distributed. The effect of nickel on a carbon-iron solid solution is well known, it strongly and progressively retards the Austenite-pearlite transition (hence the matrix sorbitising effect of which Mr. Turner writes), and it is quite understandable that if the formation of *pro eutectoid* cementite is delayed, then the splitting up of that constituent to form graphite will also be delayed and occur at such temperatures that the metal structure is relatively rigid, hence the pro-eutectoid-cementite. Graphite will not be able to "crystallise out" into large coarse particles; but is the splitting up of the *eutectic* cementite also delayed? Briefly, is only the secondary graphite nodulised and scattered, or does this occur to the primary graphite also?

In any case, whether the effect is partial or complete, in conjunction with the transition-retardation effect on the matrix, it would seem to explain quite adequately the apparent paradox that the nickel cast iron is harder, yet easier to machine, for the matrix is rendered tougher, harder, and in itself more difficult to machine, but it is more finely divided up by a greater quantity of soft graphite which causes the material to "crumble" more readily under the tool, though the harder tougher matrix holds the structure up against superficial pressure. As regards the analysis given at the top of col. 2, p. 60, and maximum hardness in a certain section. C, 3.0; Si, 1.0; Ni, 3.0 to 3.5; and Cr, 0.7 per cent. If the matrix were of eutectoid composition, then with this amount of nickel and slow cooling it would be roughly of sorbitic structure, as stated by Mr. Turner, but if the amount of nickel were increased to 4.0 per cent., or just over, the silicon being lowered to keep the amount of combined carbon constant, the matrix would now be of "self hardening" composition, and martensitic in structure. I think it possible that a Martensite plus nodular graphite structure might prove well worth investigation for heavy friction duty, particularly as the amount of chromium could be adjusted to give great toughness and stability at high temperature to the Martensite.

These very hard structures would probably be relatively machinable if sufficient graphite were present, and would attain a superlative polish.

The results obtained, as described by Mr. Turner, for normal irons containing nickel, bear some resemblance in part to those claimed for Perlit iron, viz., nodulising and fine dissemination of graphite, equalising of the structure in different sections, and refinement of the matrix: in this last respect the alloy irons go a step farther than the other material, and it would be most interesting to know what results could be obtained with a suitable nickel or nickel-chrome iron cast in accordance with the Lanz principles.

Mr. Turner makes it clear that nickel in part replaces silicon: it should be possible to give an approximate relationship in "greying" value between the two elements, and this information would be most interesting to founders.

The paragraphs on the method of adding the nickel and chromium to the metal interested the present writer very much as he has had some experience in the matter. It is, of course, most undesirable that the chromium should go through the furnace, due to its readiness to become oxidised, and its addition in the ladle therefore becomes necessary. This can be very well done by adding ferro-chromium in small lumps previously heated to dull redness, and it is rather surprising that Mr. Turner did not find this method used in the United States. Nickel, on the other hand, does not oxidise at all readily, and for the sake of thorough incorporation may profitably be charged into the cupola or air furnace. The writer has made nickel steel in a Tropenas converter when the nickel was present right through the blow and with certain precautions losses proved to be negligible, so that the inclusion of pig nickel with the charge should be sound practice.

The "Cupalloy" method sounds most interesting, and further details would be welcome, as also would be some on the use of high-silicon nickel, which might be of value for reverberatory furnace practice—particularly percentages and melting points—amount of Si passing into the metal, etc.

May I, in conclusion, express sincere thanks to Mr. Turner and to you for providing a most interesting and suggestive matter for consideration.—I am, Sir, Yours, etc.,

F. D. CORBIN.

181, Tyrfran,
Llanelly, Carmarthenshire.
February 8, 1927.

Sand Control.

To the Editor of THE FOUNDRY TRADE JOURNAL.

SIR,—Your issue of February 10 is especially interesting to those who dabble in scientific sand control. Your leader and the reports of lectures by Mr. West and Mr. Logan all offer food for thought. I was particularly struck with the concluding paragraph of Mr. Logan's Paper, which puts forward a point to which I tried to draw your readers' attention in an article in November, 1924. I refer to the chaotic state of our methods of testing sands and the crying need for some such influential body as the Institute of British Foundrymen to set up a technical committee to put the matter on a sound basis.

Admirable work has been done by the American Foundrymen's Association in this direction, but British foundrymen have shown no inclination to conform to the American standards. Considerably different conditions obtain in English and American foundries, and I think we are more likely to achieve esteem and universal adoption for tests put forward by a British Committee.

As Mr. Logan points out, everybody in this country seems to have a different set of apparatus for carrying out tests on sands, and in fact there is considerable variation of opinion on the relative importance of the different tests. Upon the latter point we cannot hope to obtain uniformity until it is possible to correlate the results of alleged similar tests made by different workers. In the laboratory under my control there is a set of apparatus for sand testing made from odds and ends of available materials, and although I can understand the results obtained I cannot compare them with my neighbour's—professionally speaking—because his apparatus is made from a different sort of odds and ends. I would willingly, however, use standard tests were such available and recognised.

Yours, etc.,

H. C. DEWS.

Dewrance and Company,
165, Great Dover Street, London, S.E.1.
February 14, 1927.

MR. H. G. SOMMERFIELD has converted his business of pig-iron exporter and merchant into a limited liability company. This will afford better facilities for handling his ever-increasing activities. The office accommodation at Charterhouse Chambers has also been increased.

Quality Castings from Quality Patterns.

By J. E.

Most foundrymen will agree that patterns are frequently used long after they ought to have been discarded. What are called standard patterns in many shops give only a rough outline of the shape required. A standard body is used on which new branches are fitted for each job, and it is not possible to do good work with it. Many firms are extremely reluctant to destroy a pattern as long as there has been no radical change of the design. In periods of slackness standard patterns should be examined, and replaced when they are so worn that they are costly to mould, but it is very seldom this is done.

It is difficult—indeed impossible—to define a good pattern. Much depends on the purpose for which it is required. It is sometimes more convenient with one-off jobs to leave a lot to the foundry, but many firms now find it facilitates production to use straight strips of machined fillet, which can be quickly sprigged in position. Leather fillet—and also wax fillet—is costly for cheap work, and lead fillet is seldom satisfactory. When the lead fillet is used the moulder has generally much finishing to do, which is one reason probably why it is not much used now.

Some patternmakers speak as though all solid patterns were first class and all skeleton bad. This is merely foolish. It is not proposed to discuss here the relative merits of strickled work, skeleton work and solid work, but as satisfactory a moulding pattern may be made skeleton as solid. Then a hastily made pattern may not take longer to mould than one that is constructed on the best principles if only one or two castings are required.

Taper.

If the maximum taper is left on square sides and on the ribs that have to be drawn into the mould, the moulder will have very little making-up to do. Making-up moulds takes much time, and the results are not always satisfactory. It is sometimes thought necessary to finish patterns for moulding-machine work that will not require making-up, while hand-moulding work is thought to be in quite a different category. This is foolish practice. The ideal which should be aimed at is to reduce the necessity for patching all moulds to a minimum, although it is not an ideal that can be achieved, because with the cleanest draw there are usually some corners that want making-up. Almost as impossible as taper is a smooth surface on the faces of the pattern. Some otherwise excellent patternmakers are prone to overlook this.

Weight of Castings.

Castings often weigh more than has been calculated. The moulder naturally makes sure that he has metal thicknesses. In his view it is always better to have the metal thicker rather than thinner than required. The writer has a recollection of some engine cylinder patterns that were made of spruce. Several castings were required, and after the first one was made parts of the pattern had so shrunk and become so badly warped that the flanges, bosses and other parts had to be thicknessed-up, and both cores and mould cost many hours of labour. The first economy in timber was an ultimate loss, and at the marking-off table also much time was wasted. Costly patternmaking invariably results in cheap moulding. There are times when it is only possible to make a rough, solid pattern, or it may be profitable to do so. It all depends on the job.

Rounds and Fillets.

Too much consideration cannot be given to rounds and fillets, it is not difficult for the moulder to deal with these. On the other hand, more time may be occupied than if they were made before the pattern left the pattern-shop. With a large fillet of, say, three or four inches radius, it is a simple matter for the patternmaker to cut a few sectional pieces and sprig them on the pattern, with spaces between. The moulder can then fill between them with sand, and in this way he obtains a full fillet, or rather round, on his mould.

It is sometimes thought that with thick metal the radius of the fillet does not matter so much, but there are reasons why it does matter. It is a fact that in green-sand moulding it is much better not to touch the face of the mould after the pattern has been withdrawn. A better surface is obtained on the face of the casting from sand that has been rammed against the pattern. A corner that has been mended will be as strong as any other part of the mould, and there is no likelihood that it will wash off when the metal is poured, but even when every care is taken in finishing the mould face a difference will usually be noticeable between parts that have been patched and the remainder of the face, which is naturally objectionable.

The thickness of metal may depend on a fillet, and it is then very bad practice not to finish them in the pattern-shop. In light work, for instance, it may be necessary to have a fillet of $\frac{1}{2}$ in. radius on the pattern, and in the core-box a radius of $\frac{3}{4}$ in. If the work is left to the moulder the metal may be $\frac{3}{16}$ in. or $\frac{5}{16}$ in., and this discrepancy may seriously interfere with the usefulness of the casting. When a number of castings are wanted it is often profitable to have the thickness tested in the foundry and the pattern altered to obtain an exact thickness.

With irregular shapes, and intricate cores even, it should be possible for the patternmaker to make the right work right in the first instance, but mistakes do occur, and with very thin work more than one alteration may be necessary. It sometimes happens that a foundry gets an order for twenty or more castings, and the pattern is so badly made that much rubbing and patching of each mould has to be done. Thus foundry costs are run up, and with a large job the weight of the casting may differ more than it ought to do.

Statistics of the Iron and Steel Industries in 1925.

The National Federation of Iron and Steel Manufacturers have just issued "Statistics of the Iron and Steel Industries (1925)," being their annual review of world production, imports and exports of iron and steel. As might be expected, about one-third of the volume is devoted to Great Britain, this section giving full details relating to pig-iron, steel ingots, semi-finished and finished iron and steel. Sections are devoted to prices; labour and wages; to iron ore, coal and coke; imports and exports. The output and value of minerals used in iron- and steel-making are included, in addition to shipbuilding statistics.

The production statistics are based upon returns made to the Federation by iron and steel manufacturers throughout the country, and, owing to their hearty co-operation, figures are now more complete than at any other period. Production figures, for instance, of pig-iron and steel are based upon returns covering 99 per cent. of the total production of the country; those for labour and wages represent approximately 92 per cent. in the case of pig-iron and 90 per cent. in the case of steel, and figures of materials consumed in the production of pig-iron, 96 per cent.

In the section dealing with the United States, a table has been added showing the imports of iron and steel in greater detail for 1924 (the latest year available at the time of going to press). In the case of France more details are now given regarding the exports of iron and steel by product and destination, and also a summary table showing the production of coke over a series of years. Owing to changes in classification of the Belgian trade returns, the tables dealing with the imports and exports of Belgium have had to be modified, and additional tables are given showing in greater detail the imports and exports of iron and steel in 1925. It is regretted that details concerning production, materials consumed, etc., in Belgium in 1925 have had to be omitted, as the publication of these data by the Belgian Administration des Mines was not received until the volume was in the press. In the section dealing with Spain new tables have been added showing the imports of iron and steel by product and country of consignment in 1924 and the imports by products over a series of years. For the first time it is possible to give some detailed statistics for Japan and a section has been introduced for this country. Tables are given showing the production of iron ore, pig-iron, steel ingots and castings and finished steel over a series of years, and imports of iron and steel by product and country.

The volume can be obtained from the offices of the National Federation of Iron and Steel Manufacturers, price 5s. 4d., post free.

The Heat-Treatment and Growth of Cast Iron.*

By J. W. Donaldson, B.Sc., A.I.C.

Numerous investigations have been carried out during the last twenty years on the influence of heat-treatment on the properties of grey cast iron. The subject is one of considerable industrial importance, as many engineering parts have to sustain conditions of considerable temperature for more or less prolonged periods of time. An admirable review of the work that has been done is given by Hurst in his book on the "Metallurgy of Cast Iron," so that it is not necessary to do more than refer to one or two of the more important conclusions arrived at.

Decomposition of carbide in grey cast iron takes place at temperatures below the pearlitic change point. The extent of the decomposition depends on the silicon content, being more pronounced the greater the quantity. It also depends on the temperature and the duration of the heat-treatment. Additional elements, such as manganese, tungsten, and chromium, retard very considerably the decomposition of the carbide. Microscopic examination of low-temperature heat-treated cast iron confirms the results obtained analytically with reference to decomposition of the carbide.

The tensile strength of grey cast iron at first falls off as the temperature increases, then increases to a maximum usually in the vicinity of 400 deg. C., after which it decreases rapidly as the temperature increases. Irons which have been subjected to a preliminary heat-treatment before testing show consistently lower values when tested at elevated temperatures than those obtained in the normal irons tested under similar conditions. The depression which is noted in the normal irons is absent in the heat-treated irons. The influence of varying proportions of manganese, tungsten, and chromium not only increase the initial tensile strength but also yield a higher strength value at temperatures up to 500 deg. C.

Volume changes or growth in grey cast irons take place after repeated heatings and coolings at temperatures below the pearlite point. The extent of these changes, which are no doubt largely due to carbide decomposition, are modified by the composition of the iron and the addition of special elements. Chromium in quantity produces actual shrinkage after repeated heatings and coolings.

These conclusions have been arrived at, as previously mentioned, as the result of various investigations to which the author has contributed. In the discussion on his Paper on "Low-Temperature Heat-Treatment of Special Cast

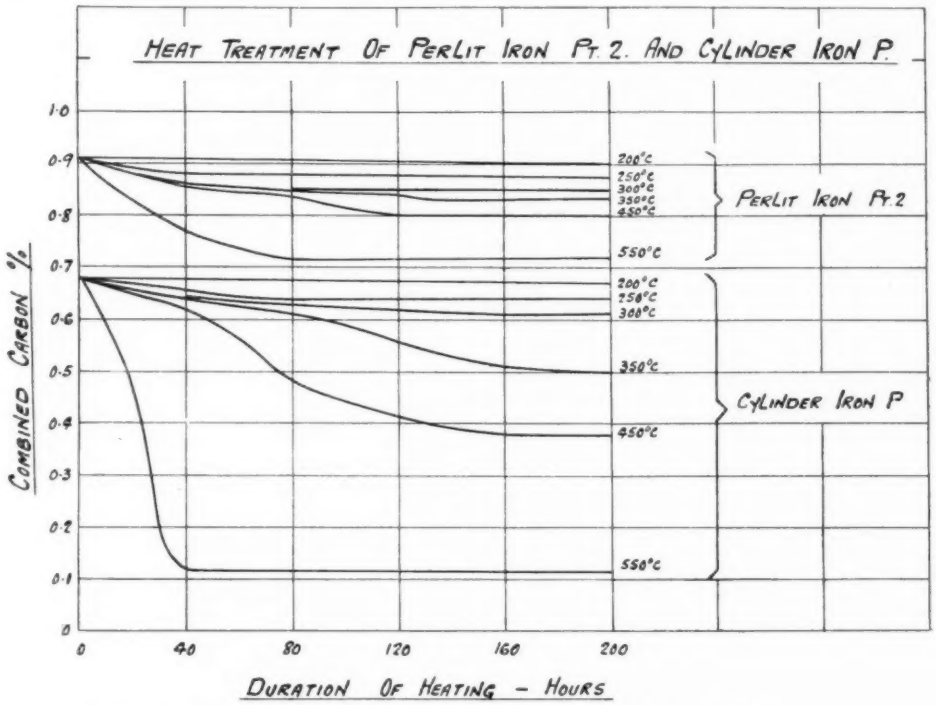

FIG. 1.—HEAT TREATMENT OF PERLIT IRON PT. 2 AND CYLINDER IRON P.

TABLE I.—*Analysis and Strengths.*

Mark.	O.	P.	Pt. 1.	Pt. 2.
	Per cent.	Per cent.	Per cent.	Per cent.
Graphitic carbon ..	2.75	2.48	2.33	2.44
Combined carbon ..	0.45	0.68	0.87	0.91
Total carbon	3.20	3.16	3.20	3.35
Silicon	2.19	1.48	1.05	0.65
Sulphur	0.064	0.054	0.123	0.117
Phosphorus	1.01	0.704	0.34	0.17
Manganese	0.79	0.97	0.57	0.85
Tensile strength Tons per sq. in.	11.2	16.6	15.0	18.3
Transverse strength Lbs. per sq. in.	2,912	3,472	3,394	3,017

TABLE II.—*Heat Treatment at 450 deg. C.*

Cast iron.	Duration of heating in hours.	Total carbon.	Combined carbon.	Tensile strength tons.	Brinell hardness.
P	0	3.16	0.68	16.6	223
	40	3.17	0.64	16.2	212
	80	3.17	0.48	15.7	197
	120	3.19	0.43	15.3	183
	160	3.13	0.38	15.4	183
	200	3.15	0.38	15.5	179
Pt. 2	0	3.35	0.91	18.3	217
	40	3.33	0.88	18.0	212
	80	3.33	0.84	17.7	207
	120	3.32	0.80	17.3	201
	160	3.32	0.80	17.3	197
	200	3.32	0.80	17.5	201

* A Paper read before the Lancashire Branch of the Institute of British Foundrymen, Mr. S. G. Smith presiding.

Irons," read at the Glasgow Conference of the Institute in 1925, it was suggested that a series of heat-treatment tests should be carried out on cast iron cast by the Perlit process. It was also suggested in a Paper by J. E. Hurst that the experiments on carbide decomposition had been carried out at 450 deg. C. and 550 deg. C., and that the minimum temperature at which this decomposition takes place had not been determined. As those two points are of considerable industrial importance, it was decided to carry out further experiments along these lines.

Materials Used.

The composition of the irons selected for these experiments, together with their tensile strengths, are given in Table I. "O" is an ordinary iron used for general engineering work. The tests were carried out on test bars which were cast on a casting. "P" is a cylinder iron of a composition which has given good results in service and was cast in dry-sand moulds in the form of test bars 14 in. by 1⅛ in. diameter. "Pt. 1" is an iron cast by the Perlit process in the form of test bars cast on a casting, while "Pt 2" is also cast by the Perlit process, but the test bars in this case were cast separately in bars 14 in. by 1⅛ in. diameter.

Heat Treatment Tests.

Heat-treatment tests were subdivided into two groups, one dealing with carbide decomposition, strength and hardness, and the other with carbide decomposition alone, and the minimum temperature required to produce it.

The first group of tests was carried out in two series. In the first series five bars of "P" and "Pt 2" were heated in separate electric resistance furnaces to a temperature of 450 deg. C. for 8 hours, cooled overnight, then reheated again to the same temperature the following day. After each 40 hours' heating a bar was removed from each furnace and its combined carbon content, tensile strength, and Brinell hardness determined. A similar procedure was adopted in the second series of tests, only the bars were heated to 550 deg. C. The results obtained are given in Tables II and III.

In the second group of tests, bars from each of the four irons were heat-treated in a similar manner at six temperatures, varying from 200 deg. C. to 550 deg. C. After each 40 hours' heating, a piece from each of the bars was

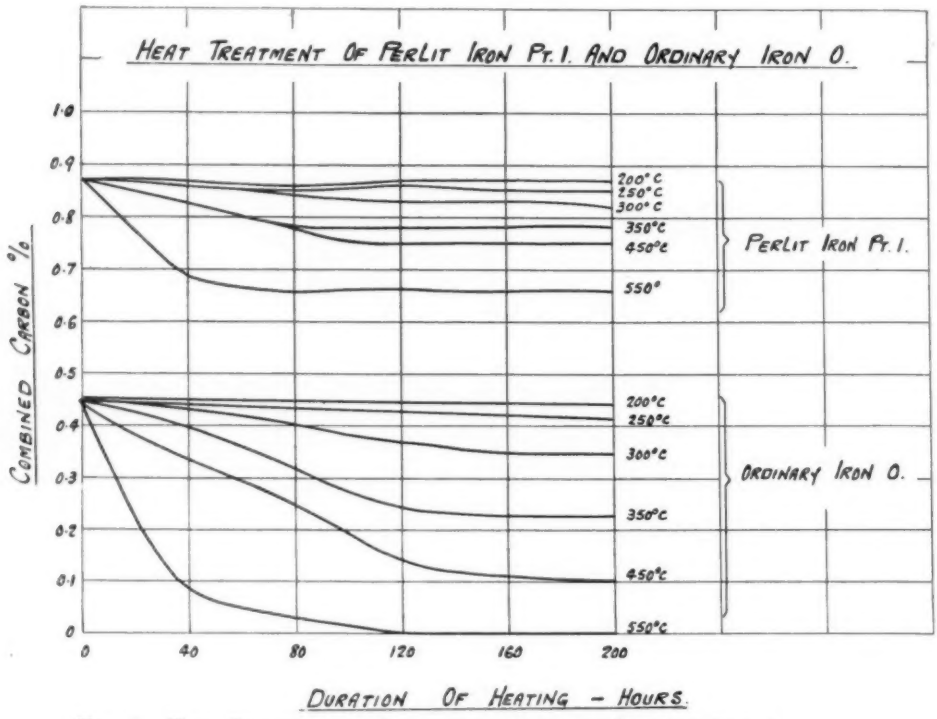

FIG. 2.—HEAT TREATMENT OF PERLIT IRON PT. 1 AND ORDINARY IRON O.

TABLE III.—*Heat Treatment at 550 deg. C.*

Cast iron.	Duration of heating in hours.	Total carbon.	Combined carbon.	Tensile strength tons.	Brinell hardness.
P	0	3.16	0.68	16.6	223
	40	3.13	0.12	15.8	138
	80	3.16	0.11	15.1	129
	120	3.15	0.09	14.8	129
	160	3.15	0.12	14.6	125
	200	3.14	0.12	14.8	129
Pt. 2	0	3.35	0.91	18.3	217
	40	3.33	0.77	18.0	201
	80	3.32	0.72	17.5	197
	120	3.31	0.70	17.0	192
	160	3.34	0.72	17.2	192
	200	3.34	0.72	17.0	192

TABLE IV.—*Heat Treatments at Various Temperatures.*

Cast iron.	Duration of heating in hours.	Temperature of Heating °C.					
		200	250	300	350	450	550
O	0	0.45	0.45	0.45	0.45	0.45	0.45
	40	0.44	0.44	0.43	0.40	0.33	0.08
	80	0.44	0.42	0.40	0.32	0.27	0.04
	120	0.45	0.43	0.37	0.24	0.14	Trace
	160	0.44	0.41	0.35	0.22	0.11	Trace
	200	0.44	0.41	0.35	0.23	0.10	Trace
P	0	0.68	0.68	0.68	0.68	0.68	0.68
	40	0.68	0.66	0.65	0.65	0.64	0.12
	80	0.67	0.64	0.64	0.61	0.48	0.11
	120	0.68	0.65	0.63	0.56	0.43	0.09
	160	0.68	0.64	0.61	0.51	0.38	0.12
	200	0.67	0.64	0.61	0.50	0.38	0.12
Pt. 1	0	0.87	0.87	0.87	0.87	0.87	0.87
	40	0.87	0.86	0.86	0.83	0.83	0.68
	80	0.86	0.85	0.84	0.78	0.78	0.65
	120	0.87	0.86	0.83	0.78	0.74	0.66
	160	0.87	0.85	0.83	0.79	0.75	0.65
	200	0.87	0.85	0.82	0.78	0.75	0.66
Pt. 2	0	0.91	0.91	0.91	0.91	0.91	0.91
	40	0.89	0.87	0.86	0.85	0.88	0.77
	80	0.90	0.87	0.85	0.86	0.84	0.72
	120	0.90	0.88	0.85	0.84	0.80	0.70
	160	0.89	0.88	0.85	0.83	0.80	0.72
	200	0.90	0.87	0.85	0.84	0.80	0.72

removed and its composition as regards combined carbon determined. The results obtained are given in Table IV.

Consideration of these tables shows that carbide decomposition takes place in all the irons but varies considerably, according to the temperature of treatment and iron tested. At 200 deg. C. the amount of decomposition after a period of 200 hours' treatment is in each case so slight as to be almost negligible. As the temperature, however, increases decomposition is more pronounced and varies for each iron. The amount of decomposition for the various temperatures is represented graphically for each iron in Figs. 1 and 2.

With the ordinary iron there is a steady increase in the rate of decomposition as the temperature rises, being pronounced at 350 deg. C. and almost total at 550 deg. C. The cylinder iron shows marked decomposition at 450 deg. C., and at 550 deg. C. 82 per cent. of the carbide is decomposed. In the two Perlit irons decomposition is less marked, the "Pt 2," which has the lower silicon content, showing only 20 per cent. carbide decomposition at 550 deg., as against 25 per cent. in the "Pt 1."

In all the irons decomposition takes place steadily for the first 120 hours' heating at all temperatures except at 550 deg. C., and then remains more or less steady. At 550 deg. C. decomposition practically all takes place during the first 40 hours' heating.

A summary of the results obtained for the four irons as regards carbide decomposition, loss in strength, and hardness at 450 deg. C. and 550 deg. C. respectively, is given in Table V, together with results for three irons of composition similar to the cylinder iron but containing 0.392 per cent. of chromium, 0.475 per cent. of tungsten, and 0.495 per cent. of chromium and 0.245 per cent. of nickel respectively.

As mentioned previously, the best results as regards carbide decomposition are obtained at both 450 deg. C. and 550 deg. C. with the two Perlit irons, followed by the cylinder irons containing special element additions. This carbide change is reflected in the corresponding decreases in strength and hardness.

It would appear from these tests that the stability of the carbide in grey cast iron under low-temperature heat-treatment conditions is influenced by the silicon content. This effect is most pronounced when the silicon is 1.0 per cent. or less. An iron containing 1.05 per cent. of silicon shows only 25 per cent. carbide decomposition at 550 deg. C., as against 82 per cent. for an iron

TABLE V.—*Percentage Changes Produced by Heat Treatment.*

Cast iron.	450°C.				550°C.			
	Duration of heating in hours.	Combined carbon decrease.	Tensile strength decrease.	Brinell hardness decrease.	Duration of heating in hours.	Combined carbon decrease.	Tensile strength decrease.	Brinell hardness decrease.
		Per cent.	Per cent.	Per cent.		Per cent.	Per cent.	Per cent.
O	160	77.7	—	—	120	100.0	—	—
P	160	34.0	7.0	18.0	40	82.0	11.0	42.0
Pt. 1	120	16.0	—	—	80	25.0	—	—
Pt. 2	120	12.0	4.4	7.4	80	19.8	7.1	11.5
C	120	25.0	5.5	16.0	120	46.0	11.0	31.0
W	120	23.0	5.7	15.5	160	65.0	14.7	33.0
C.N.	120	25.0	6.3	14.0	160	51.0	13.0	31.0

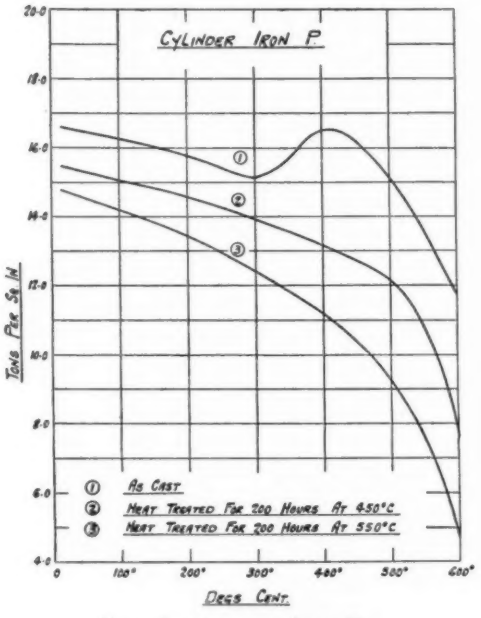

FIG. 3.—CYLINDER IRON P.

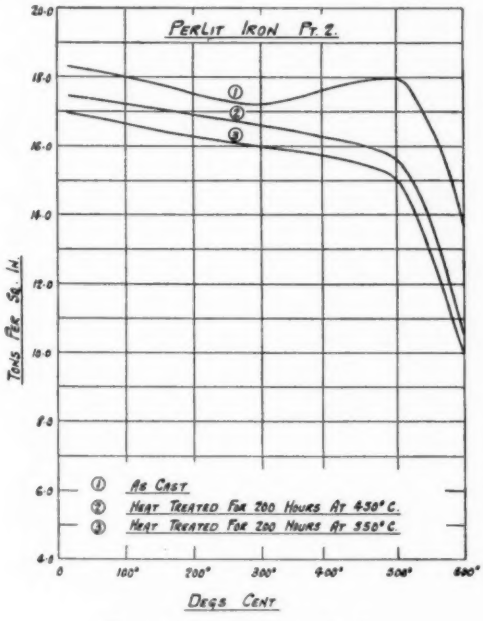

FIG. 4.—PERLIT IRON PT. 2.

TABLE VI.—*Elevated Temperature Tests.*

Cast iron.	Breaking temperature °C.	As cast.	Heat treated for 200 hours at 450°C.	Heat treated for 200 hours at 550 C.
	Degs.	Tons.	Tons.	Tons.
P	15	16.6	15.5	14.8
	100	16.1	14.9	13.8
	200	15.8	14.5	13.6
	250	15.2	—	—
	300	14.9	13.8	12.4
	350	15.7	—	—
	400	16.5	13.0	11.0
	500	15.1	12.2	10.4
	600	11.7	7.6	4.8
Pt. 2	15	18.3	17.5	17.0
	100	18.0	17.3	16.5
	200	17.5	16.7	16.2
	300	17.2	16.5	16.0
	400	17.7	16.3	15.7
	500	18.0	15.7	15.2
	600	13.7	10.5	10.0

containing 1.48 per cent. of silicon. Even the addition of 0.4 per cent. of chromium to the higher silicon iron does not produce the same degree of stability. Lowering the silicon to 0.65 per cent. only increases the stability to a slight extent, the most marked change taking place between 1.0 and 1.5 per cent. of silicon. This might suggest some critical composition of silicon which affects stability if those lower silicon irons, due to their process of manufacture, did not have a higher initial combined carbon and an all-pearlitic structure. It appears probable that the marked increase in stability is a result of the lower silicon content combined with the higher initial combined carbon. This appeared to be confirmed by a test carried out on an iron having 0.89 per cent. combined carbon, 1.78 per cent. silicon, and a pearlitic structure. After 200 hours' heat treatment at 550 deg. C. the carbide had decomposed to the extent of 48 per cent.

Elevated Temperature Tests.

A series of bars from the cylinder iron "P" and the Perlit iron "Pt 2" were broken at temperatures ranging from 15 deg. C. to 600 deg. C. A second series from each iron were heat treated at 450 deg. for 200 hours (and a third series were heat treated at 550 deg. C. for a similar period), in order to produce more or less stable conditions as regards carbide decomposition. After heat treatment, bars from each series were broken over a range of temperatures similar to which the irons in their cast condition were broken. The results obtained from these tests are given in Table VI and represented graphically in Figs. 3 and 4.

The Perlit iron tested in its cast condition shows, as in the case of the cylinder iron, the characteristic drop which takes place in the temperature strength curve at 300 deg. C. This depression in the curve is removed in both irons after they have been heat treated. The Perlit iron in its cast condition, and also after heat treatment, retains its strength up to 500 deg. C. before falling off. In this respect it behaves somewhat similar to the cylinder iron containing 0.392 per cent. of chromium, dealt with in a previous Paper. Similar to the chromium iron, it also retains its strength after heat treatment. As compared with the Perlit iron, the cylinder iron in its cast condition tested at 500 deg. C. shows a drop of 16 per cent. After heat treatment for 200 hours at 450 deg. C. and 550 deg. C. the drop in strength when tested at 500 deg. C. is 19 per cent. and 28 per cent. respectively. These results are consistent with the results obtained in the carbide decomposition tests, the Perlit iron being the more stable under the higher temperature conditions.

(To be continued.)

Continental Steel Trust.

As briefly reported previously, German adherents of the Continental Steel Trust were stated to be expressing dissatisfaction with their position, and were even threatening to withdraw from the Trust. It now turns out that this statement was based upon a speech delivered by Commercial Councillor Reusch, general director of the Gutehoffungshütte, at a recent meeting of the Duisburg Chamber of Commerce, of which he is the chairman. In hinting at notice being possibly given to terminate the Steel Trust, the general director is reported to have stated that no confidential economic co-operation with their neighbours was possible without the evacuation of the occupied districts. The German negotiators of the Trust at that time had tacitly proceeded on the assumption that international co-operation would gradually contribute towards an improvement in the external political situation. Unfortunately the experience of the past few months had shown that the Germans were premature in their assumption. The question would have to be seriously considered as to whether the present was a suitable time to make further international economic agreements, especially as here and there in Germany voices had been raised in favour of the abolition of the international agreements already concluded.

The above was the first occasion for the question being raised in public as to the possibility of notice being given to determine the agreement concerning the Continental Steel Trust, although it is considered doubtful whether Herr Reusch's suggestion will meet with the approval of the whole of German industry. But considerations other than those of an evidently political character are also said to be at the back of the problem, namely the economic displacements which have occurred since the Steel Trust came into operation on October 1, 1926. In order to obviate the underselling favoured by the inflated currencies of their neighbours, the Germans had made, as they claim, considerable sacrifices in the matter of the allotments conceded to France and Belgium when concluding the Steel Trust. Belgium, which country obtained an allotment based on her record production, has since stabilised her currency, and the value of the French franc has improved by more than one third. As these changes have not brought about a reduction in the costs of production, the sphere of sales of these two western countries has considerably been reduced, and it has become more difficult for them to reach the allotments granted to them under the Trust. On her part Germany, with the cessation of the dumping by her neighbours, due to their debased currencies, has increased her competitive power in foreign markets, so that her allotment has been considerably exceeded, and on the occasion of the first adjustment the question of the payment of a fine of $4 per ton, fixed by the agreement, will become actual for the tonnage made in excess of her allotment. The first cash settlement is to take place on April 1, and for the first three months of the agreement Germany has become liable to a fine of from 8,000,000 to 9,000,000 marks (£400,000 to £450,000).

This being the case, it is impossible to foresee what further development there will be. Reports from France and Belgium in the meantime are becoming more numerous that a considerable abatement is taking place in the number of orders and in the stock of orders on hand, and of short-time working, as the Western countries, owing to the recent increase in their costs of production, are no longer capable of competing to the same extent as they were formerly. A further important factor is the resumed activity of the British steel industry, which in turn directs attention to the still unsolved problem of roping in the British industry in the Continental Steel Trust. The question of the inclusion of Great Britain is considered to be of paramount importance for the continued existence of the Trust, as a certain stabilisation of European steel prices is impossible without the inclusion of Great Britain in the Trust. This will be clearly perceptible when the British industry has reached the stage of full capacity production, and will appear again as a seller on Continental markets. As compared with Great Britain, the inclusion of the Austrian, Hungarian and Czech works is of minor importance.

As to the question of notice being given to terminate the Continental Steel Trust, it is pointed out that this will only become possible on May 1, 1929, and the notice would only become operative on October 1 next following. Only in special cases is an earlier notice possible. For instance, this would occur if the Franco-German Treaty of Commerce were not concluded. It would also be possible if the share of the interested countries in the aggregate production of the European countries involved during six months were 5 per cent. less than their share during the first quarter of 1926. In this event the termination of the agreement would become effective after three months' notice. Besides these contingenices, the agreement can be annulled by three months' notice being given by each of the interested groups in the case of the total allotments fixed for any half year falling below 13,139,000 tons.

As will be seen, the date at which it would be possible to give formal notice to determine the agreement is still far distant. In the meantime, it is held, an opportunity is afforded by means of negotiations to secure the removal of the inconveniences which have resulted for one or the other parties to the agreement in its present form.

The Committee of the Continental Steel Trust, with which the Austrian, Hungarian and Czech works became associated as from February 1, are to meet this week in Luxemburg. Concerning the proposed inclusion of the Polish works in the Trust it is stated that French interests are insisting on a continuation of the negotiations with the Polish works, especially as the Polish Iron Syndicate was extended on January 13 and now embodies all the Polish works, so that a fresh basis for discussion has been created on the one hand, and on the other the Poles have gained increased strength. In the case of Italy it is stated that as a result of the large imports of raw materials into that country a suitable basis for negotiations will be found in the near future so as to bring the Italians within the scope of the Trust. As to the Swedish and Spanish works, contact with these is being maintained, but the discussions are proceeding very slowly, corresponding to the difficulties involved in the formation of such agreements.

THE Furness Shipbuilding Company report the receipt of an order valued at £1,000,000 for the construction of six ships.

The Early History of the Institute of British Foundrymen.*

By F. J. Cook, Past-President of the I.B.F.

It is a remarkable fact that although the Association has been in existence since 1904, so far no attempt has been made to give an account of the circumstances which led to its formation or to tell the story of its early developments. It is important that these details should be given since the lapse of time has reduced the number of the foundrymen who formed the Association and set it on its forward path. It will be the object of this paper to detail very briefly the origin and progress of the Association up to the present time.

Incidentally, no better example of the power of the Press could be given, since it was in the pages of THE FOUNDRY TRADE JOURNAL that the first aspirations for an association found their expression. The first issue of THE FOUNDRY TRADE JOURNAL appeared in January, 1902. It is clear that at that time there must have been, although more or less lying dormant for lack of the means of expression, a desire for a foundrymen's association on the lines of the American one. For as early as the second issue of THE FOUNDRY TRADE JOURNAL two letters appeared under the *nommes des plumes* of "Foundryman" and "Foundry Foreman," both of which urged the formation of such an association.

These were followed in the May issue with a letter on similar lines signed "Foundrymite." After that time, no doubt owing to lack of initiative and pushfulness, the matter appears to have laid dormant, as no further letter on the subject appeared until May, 1903, when J. Ellis (Southampton), who subsequently became President of the Association, wrote under the *nom de plume* of "Foundry Manager," again urging the formation of such an association and suggesting that the first general meeting should be held at Manchester in connection with the forthcoming Exhibition. In the next issue of June a writer signing himself "T.S.," whilst agreeing in principal with the suggestion, pointed out what he believed to be insurmountable difficulties, including that of cost. Just prior to this Mr. Finch, the present Treasurer, had been reading in the issues of the American journal "The Foundry" accounts of the American Conventions and was strongly impressed with the desirability of forming a similar association in Great Britain. At the same time he learned of the existence of THE FOUNDRY TRADE JOURNAL, and, with his characteristic energy wrote in the June issue giving a practical turn to the discussion by suggesting that if those interested in the formation would communicate with him he would take the initiative. At the same time he recalled a previous attempt he had made to form a foundry managers' association.

The First Meeting.

The discussion vigorously continued and in the July issue letters appeared from Mr. Finch and "Foundry Manager" both making light of the difficulties suggested by the correspondent "T.S." A further practical suggestion came from Mr. Finch to the effect that the Editor should provide space for the insertion of names and addresses of those interested. "Foundry Manager" again urged the holding of a general meeting in Manchester, suggesting that the seventy foundries in that district would no doubt combine to see the thing successfully carried through. More letters appeared on similar lines with Editorial notes in practically every issue. But still the matter flagged and in November, 1903, the Editor, in his notes was very despondent at the apparent lack of progress and emphasised the necessity of Mr. Finch's slogan. "Wake up." In December, 1903, appeared an excellent article by Dr. Percy Longmuir entitled "A Foundrymen's Association, Its Possibilities and Advantages to the Foundry Industry." In the same issue appeared an enthusiastic letter from J. A. Phillips, some helpful Editor's notes, and a letter from a Scottish representative of the JOURNAL, stating that a suggestion for the formation of an association had been well received by the Scottish foundries. Still the actual formation was delayed, until Mr. Finch, taking his courage in both hands, invited, through the medium of the JOURNAL, all those interested in the formation of an association to meet him at the Cobden Hotel, Birmingham, on Saturday, April 9, 1904. This appeal resulted in the appearance of seven gentlemen, namely R. Buchanan (Birmingham), C. Morehead (Rugby), J. Ellis (Southampton), F. W. Shaw, W. Vickers, F. J. Cook (Birmingham) and F. W. Finch (Gloucester).

Nothing daunted with this poor response to the appeal, the handful of pioneers decided to make a bold effort by circularising all the foundries with more than five moulders, and in the event of failure each one present at that meeting undertook to share the costs. The details relative to the foundries were obtained for this purpose from the annual report of the Moulders Society and those for Scotland from Mr. Jack, the Secretary of the Scottish Moulders Union. Mr. Roxburgh (Kilmarnock) was very helpful at this stage in classifying the Scottish list.

First Results.

The second meeting revealed the fact that the acting Secretary, Mr. Finch, had received about fifty applications for membership, and this was considered to be so satisfactory that the meeting proceeded to form an association, with officers and Council. At that meeting Mr. R. Buchanan was nominated as President, Mr. Finch Secretary and Treasurer, and those present to form the Council with power to add to their numbers. It was also decided to hold a Convention during the August Bank Holiday week at Manchester. Mr. J. G. Stewart, of Urmston, Manchester, who was present at the meeting, undertook to make the necessary arrangements for that Convention. By the time of the Convention 89 members had been enrolled of whom over 50 attended, and it can safely be asserted that no Convention has ever been more thoroughly enjoyed, or at which a larger percentage of the members have attended. Friendships were made on that occasion that have lasted until the present day. By the end of the year 1904 the membership had increased to 100.

Initial Objects.

The Council gave a great deal of thought and attention to the question of defining the lines on which the Association should be run, and though many ideas were never put into writing some of them have always been well understood and considered as unwritten laws. The primary object was considered to be purely educational—the education of the man actually at work in the foundry, such as workmen, foremen and managers. This was to be followed by educating those outside the shops who are more or less directly or indirectly concerned with it, such as draughtsmen, patternmakers, proprietors and works managers, etc. As an incentive to membership the subscription was placed at the absurdly low figure of 7s. 6d. per annum. It was also definitely decided that the Association should not countenance any discussion of Trade Union matters, whether appertaining to wages or conditions of labour. Further, the Association was not to be used in any sort of propaganda for business houses in the selling and advertising of their goods. The success which has followed the ideals set up in those early days proves that the Association was well and wisely governed from its inception.

The Official Organ.

In December, 1904, after discussion by the Council in conjunction with Major Cheesewright, it was decided to appoint THE FOUNDRY TRADE JOURNAL as the official organ of the Association.

*A Paper read before the Lancashire Branch of the I.B.F., Mr. S. G. Smith presiding.

This step was considered an economical way of keeping directly in touch with the members, as at that time the Association funds would not allow of heavy expenditure. The members were allowed a rebate on the JOURNAL by the proprietors, who also undertook to provide space for reports or communications from foundrymen. In furtherance of this idea, and also for the purpose of drawing up a set of rules for the Association, a literary committee was formed comprising Mr. Buchanan and the author, this committee promising to provide articles from time to time in the JOURNAL on points appertaining to the welfare of the Association. The first of these articles appeared in the March issue of 1905 over the initials of "F.J.C." (the author). In this article the writer pointed out the inadequacy of one meeting a year to such an Association, and suggested that until Branches could be formed (a policy which the Council always had in mind) it was desirable that wherever members of the Association gave papers to other Societies they should stipulate that invitations should be sent to all members of the Foundrymen's Association in the district. This article was followed by others from the pens of F. W. Shaw, C. Morehead and R. Buchanan.

The First Branch.

Manchester with her natural foresight and pushfulness may well be proud of the fact that in 1905 she received the sanction of the Council to form the first Branch, to be known as the "Lancashire Branch." Its first meeting took place in the autumn of that year when Mr. Finch addressed an audience of about seven. The first President was Mr. W. Russell, of Pendleton, and the first Secretary, Mr. J. G. Stewart, of the British Westinghouse Company, a man who did valuable work at the commencement of our history both in and out of the Council. Birmingham was the next to form a Branch, its first meeting being held on April 28, 1906, under the Presidency of R. Buchanan, and the author as Secretary. Mr. R. Mason, now in Australia, also helped to found the Birmingham Section.

Several meetings were held at Cardiff with a view to the formation of a Branch. They were organised entirely by the late Mr. Charles Jones, who not only did all the work, but paid the expenses out of his own pocket. But Cardiff seemed to lack the necessary enthusiasm, and this attempt gradually faded away. About eighteen months from its formation the Association was being run on lines which have proved most successful down to the present day. That in itself speaks volumes for the time and attention given by the members of the Council, and reflects credit on their admirable foresight and business acumen.

Milestones of Progress.

The Association now having been firmly established there only remains to enumerate some of the various milestones which stand out on the high road of progress. These have been very many, and the importance of some of them is probably hardly realised to-day. But they are destined to be of great value, particularly in our worldwide relations.

During the first few years of the Association's existence, and particularly after the formation of the Branches, it soon became clear that the annual subscription of 7s. 6d. per member was not sufficient to allow of developments which were so urgently needed. The Birmingham and Cardiff Branches, realising that headquarters could not afford to pay Branch expenses, both decided to pay their own. Up to that time Birmingham had met the difficulty by a subscription of 3s. per annum from each Branch member, and, as previously mentioned, Mr. Jones had himself paid the expenses of the Cardiff Branch. But the parent body continued to finance the Lancashire Branch, and this fact brought forth comment at several annual meetings when the statement of accounts came to be presented. This question, together with the desirability of printing a more extended annual copy of Proceedings, was considered by a sub-committee of the Association, with the result that the following recommendation was adopted at the Birmingham Convention in August, 1909:—

> "That a scheme of membership be inaugurated consisting of members at one guinea per annum subscription; associate member at half a guinea, and branch associates at three shillings, and all Branch expenses to be paid by headquarters."

This enabled the immediate commencement of enlarged Proceedings in their present form to be issued annually.

At the Convention in Glasgow, August, 1911, the Council put forward a scheme of Diplomas for the best paper of the year read before Branch meetings, believing that such a scheme would act as an incentive to members to write papers of an eminently practical character. It was also hoped to formulate schemes of awards for the whole Association.

Growth of Branches.

The number of Branches was gradually growing, and the inauguration of a Sheffield Branch in 1908 was followed by the Scottish Branch in 1910, London 1911, and Halifax and Newcastle-on-Tyne in 1912. The reading of papers before these Branches, the authors in many cases being eminent metallurgists, evinced a general desire among the members for a comprehensive "Glossary of Terms," to enable a better understanding of the purport of chemical and metallurgical phenomena. The sequel to this was a "Glossary of Terms" published in the Proceedings of 1911-12, this having been prepared by a sub-committee consisting of Dr. P. Longmuir, the late Mr. R. Buchanan, Dr. T. Swinden, and the author.

Another important educational question occupied the attention of the Council at that time, namely, apprentice training. A strong Committee, with Mr. Sidney A. Gimson as its Chairman and Mr. A. Hayes as Secretary, was formed, and, largely owing to the activities of these gentlemen, a comprehensive scheme was presented at the Convention in June, 1915. It was hoped and expected that it would be possible to expand this work still further, so as to formulate a definite curriculum for both shops and night-class training. But unfortunately the exigencies of the war cut short any further work on the matter.

In addition to services rendered in time by members of Council, some had furthered its interests by presentations, such as design and dies of crest for the Association by the late Mr. Charles Jones, of Cardiff, for use on the Association's notepaper. Badges were also made to be worn by members at Conventions, etc. But at the London Convention, in June, 1916, Mr. Mayer, of Dumbarton, the then retiring President, presented to the Association a valuable and beautiful President's gold chain of office, with links on which to engrave the names of the successive wearers. This was duly handed over, together with a properly drawn up legal deed of gift setting forth the terms of the present, and this chain was worn for the first time by Mr. J. Ellis, the incoming President.

Increased Fees Bring Prosperity.

In 1909, when the scale of members' subscriptions was increased, there were those who prophesied a great reduction in membership, and thereby a shrinkage in funds. This, however, proved to be unfounded, for both membership and funds increased rapidly, and by 1915 the Association had 1,047 members as compared with 448 in 1909, and the balance at the Bank in 1917 was such as to warrant an investment in War Loan to help the nation to the extent of £350.

International Connections.

The Great War of 1914 to 1918 militated against many things being done which might otherwise have been undertaken. Yet at the end of it an event took place which, though on the surface may appear to have little or no connection with the Association, bids fair to have far-reaching effects in our endeavours towards international relationship.

At the end of October, 1918, at the invitation of the British Ministry of Information, there sailed from America a party of American industrial Press representatives to inspect the battlefields, but who at the same time were specially interested in the industrial activity of Great Britain. Among the party was Mr. H. Cole Estep, of "The Foundry," who during his tour

of inspection of plants got in touch, as far as time and circumstances would permit, with several members of this Association. His return was followed in the next year, 1919, by a visit from his colleague, the late Mr. A. O. Backert, and in 1921 by Mr. John Penton. The visit of Mr. Backert synchronised with his Presidency of the American Foundrymen's Association, and as such he was warmly received and entertained officially by members of our Association at Sheffield, Coventry and Birmingham. Mr. Backert, as many of you know, was a most charming man, who endeared himself to everyone he met, and he carried back to America a very keen appreciation of the position our Association held. This appreciation he soon turned to the mutual benefit of both the American and British Associations by suggesting that there should be an annual exchange of Papers between the two countries, these papers to be given at the respective Conventions. This suggestion was warmly received, and the first exchange paper was given by the late Mr. G. K. Elliot on behalf of the American Association at the Blackpool Convention of June, 1921. In the following year, 1922, Mr. Oliver Stubbs, then our President, and the late Mr. Thomas Firth, visited the States, together with the author, who attended the Rochester Convention and presented the first paper on behalf of the British Association.

At the Birmingham Convention in the same year, June, 1922, which immediately followed the return of these gentlemen from the States, Mr. Stubbs held a private luncheon at the Midland Hotel, Birmingham, at which representatives of America, France, Belgium and Britain were present in the persons of Mr. Stanley G. Flagg, Junr., U.S.A., P.P., A.F.A.; Professor Touceda, U.S.A.; Mr. E. Ramas, France (President of Foundrymen's Association); Mr. E. V. Ronceray, France; Mr. Leonard, Belgium (President of Foundrymen's Association); Mr. Varlet, Belgium; Mr. H. L. Reason, President I.B.F.; Mr. Frank Somers, Past-President, Staffordshire Iron and Steel Institute; Mr. F. J. Cook, Past-President, I.B.F. and Staffordshire Iron and Steel Institute; Colonel Cheesewright, D.S.O., of THE FOUNDRY TRADE JOURNAL; Mr. T. H. Firth, Past-President, I.B.F.; Mr. Cole Estep, Cleveland, Ohio; Mr. V. C. Faulkner, Editor of THE FOUNDRY TRADE JOURNAL; Mr. Oliver Stubbs, Past-President, I.B.F.

There grew out of this meeting a movement for closer cordial relations between Societies holding similar ideals, a movement of a wide and international character which has now become firmly established.

The Research Movement.

Coming back to the history of the Association, the need had been felt for a long time of an Information Bureau and of some sort of facilities for the carrying out of research work. There had been given to the Association the results of research work by Coe, and also those that had led up to the "Network" Formation of Cementite and Phosphide Eutectic and the action of Blast in Cupola Working. This data, however, had been the result of individual effort and not directly the outcome of the Association. The matter was considerably influenced by a paper given at the Sheffield Convention in June, 1918, by R. Buchanan, entitled "A National Information Bureau for Foundrymen." As the result of this a special committee was appointed by the Council in August of the same year to deal with this matter. Great consideration was given to the matter from all aspects, and the committee were convinced that a body with a much wider scope than the Association was needed adequately to cope with the subject. Steps were then taken to form a Research Association under the auspices of, and in conjunction with, the Government Department of Scientific and Industrial Research. This Association came into being in 1920, and is an institution of which the Association is justly proud and in the working of which its members are taking a prominent and important part.

The Royal Charter.

At the same Council meeting, in August, 1918, a committee was formed to consider the question of applying for a Royal Charter. This was a tedious and costly business. But largely owing to the untiring efforts and perseverance of the late Mr. Thomas Firth, the Charter was secured, and without any financial responsibility to the Association.

The expenses of the Association naturally grew with the expansion and wider scope of its work, and during the year 1920 expenditure outran the income by £165. It was considered essential that a paid Secretary with an office in London should be appointed, and for this purpose, together with a desire to see the Association on a sound financial basis, the Convention held in London in August, 1920, passed the Council's recommendation to increase the membership fees to Members two guineas, Associate Members one guinea, and Associates half a guinea. It was also decided to institute a new form of membership under the head of "Subscribing Firms" at five guineas per annum, and this action has added considerably to the prestige and scope of the Institute's activities.

Oliver Stubbs Medal.

At the Blackpool Convention in September, 1921, the President announced that the National Ironfounding Employers' Federation had been pleased to offer a sum of £200 to be invested in the name of the British Foundrymen's Association, the interest from which should provide for a gold medal called the Oliver Stubbs' Medal, in appreciation of the esteem in which that gentleman was held by both Associations and this medal should be awarded annually to a member of the Institute who had shown sufficient merit to warrant it. This gift was gratefully accepted, and a sub-committee, under the chairmanship of Mr. Carey Hill, of Coventry, formulated rules to be adhered to in making the annual award. The first recipient under this scheme was the author, at the Birmingham Convention in June, 1922.

Foundry Exhibition.

That Convention of 1922 was important in other ways, for it was in conjunction with that meeting that the first Foundry Exhibition* was undertaken. It was there that Oliver Stubbs, as before mentioned, forged and welded the link of internationalism. The Exhibition was a great success, and at the Convention Papers were given by representatives from France, Belgium and the United States of America.

In the same year, 1922, W. Mayer again gave expression of his continued interest in the work of the Association by presenting funds, the interest from which would provide medals, to be called the "Surtees Medal," to be competed for annually by the Scottish and Newcastle-on-Tyne Branch members.

The international side of foundry work was steadily gaining ground, and in 1923 an international gathering was held at Paris, at which many of our members were present, as well as a large party from the United States, who previous to going to Paris, made an extended tour, and were officially entertained by our members in London, Sheffield, Manchester, Birmingham and Coventry. During 1926 the second international meeting took place at Detroit, U.S.A., when a fair number of our members attended. The exchange Paper was given by Mr. J. Shaw, and it is very gratifying to know that both he and Professor Turner were presented with gold medal awards by the American Association.

Looking back over the long years, one cannot but be impressed with the fact that the formation and destiny of this Association has been carefully and wisely looked after by men of outstanding merit and ability, both on the scientific and practical side of the industry, and to have been associated with such pioneers is a lasting delight to the author of this review.

DISCUSSION.

THE CHAIRMAN (Mr. S. G. Smith) said the address by Mr. Cook had been delightful, and would be looked upon as a historical event. It was suitable for printing separately and sending out to the Branches. The address revived memories of the past. His first acquaintance with Mr. Cook began in 1908, when Mr. Cook persuaded him to give one of his earliest Papers at the Birmingham Conference of the Institute, and they had been in close association ever since. Mr. Cook had been actively interested from the beginning, and

* This is a moot point as one was held in London at the Agricultural Hall in June, 1923.

was one of the hardest workers for its welfare. A useful addition to the address would be a statement of the names of the secretaries of the Institute and its predecessor, the British Foundrymen's Association.

Future Progress Depends on Membership.

MR. OLIVER STUBBS said it was sometimes suggested that the conduct of the affairs of the Institute was carried out by too few people, and too little work left to other members of the General Council. The reply to that was that other members would not take up the work. There were Past-Presidents who, after they had closed their term of office, did not continue to take an interest in it as they ought to do. To a certain extent that remark applied to the Branches as much as to the General Council.

They were expecting the new General Secretary, Mr. Makemson, to undertake propaganda work, and to assist him Mr. Cook's address should be reprinted and distributed widely. It presented reasons why both firms and individuals should join the Institute. He believed the work done by the Institute had accomplished more to maintain peace in the foundry industry than the joint conferences specifically held for that purpose. But it had to move onward, and the only way to continue improving was by bringing in fresh members. Considering the hard times through which they had been passing in the last three years, the membership had kept up remarkably well. Indeed, when one saw the numbers who were passed for membership at each General Council meeting, it seemed surprising that the membership did not actually increase, but, unfortunately, the newcomers only replaced those who had resigned or dropped out through inability to pay the subscriptions. He sympathised with men who had to look carefully at a guinea or two guineas in such hard times. But in the near future the Institute would recover any ground it had lost. The first step should be to leave the meeting with their minds made up that they were going to get more members. Men of some education were wanted. Let them be given Papers of a character not too academic, so that they might feel they were making some progress, and the work would not be in vain.

Double Office.

MR. H. SHERBURN, after expressing his father's regret at not being able to attend and meet his old friends, with whom he became acquainted through the British Foundrymen's Association, said at one time his father was both President and Secretary of the Lancashire Branch. Happily those days were past, but for some years the position of the Lancashire Branch was full of difficulties, and anything but pleasant. One of the best men they had ever had was Mr. Kenyon, who, unfortunately, because of advancing years, could not now take the same interest in the work that he used to do. Perhaps that reason explained why some ex-Presidents of the Institute who were pioneers of the Institute were no longer active in its cause. Mr. Cook was a brilliant example to the contrary: he had been acting right through the piece, and still carried on with undiminished vigour. That afternoon he had contributed a valuable address to which the maximum publicity should be given.

MR. HAIGH remarked that he had been a member of the Lancashire Branch since 1906. All through the members had regarded men like Mr. Cook and the late Mr. Robert Buchanan as leaders and directors in the movement. But he wanted now to appeal to the young men in the foundries. At the present time it was difficult to induce skilled operatives to take an interest in it. The people in executive positions, the scientific people, the men who held administrative posts, had become interested; it was time the man on the floor or the bench was brought in also. In his opinion the Institute was suffering now through the practical not being linked up with the academic and technical.

MR. T. W. MARKLAND said the outstanding feature of the work of the Institute was that it was educational, and he thought the young men were beginning to realise that. Proof of his statement was given by the Junior Section. The conditions to-day were very different from those which prevailed thirty or forty years ago. Men were seeking knowledge, they wanted to be educated, and the Institute would help them.

MR. T. MAKEMSON said a history of the Institute was needed; the information available about its early days was very scanty, so they had reason to be glad that Mr. Cook had had the time and the inclination to prepare this address. No one was better qualified to do so, because he had himself taken part in most of the events of those early days of the Institute.

Mr. Cook had mentioned that after 1909, when the subscriptions were increased, the membership rose. A few years ago the subscriptions were again raised, and the membership again increased. However, he did not suggest the inference was that they should make a further increase in order to get additional members. But there were many people outside to whom membership of the Institute should be invaluable. Besides the educational advantages in the form of Papers, there was the great benefit derived by associating with other people engaged in the same industry. There was plenty of work for the Institute to do. The more members they had, and the more enthusiastic they were, the better it would be for all.

Vote of Thanks.

MR. J. S. G. PRIMROSE said if Mr. Cook would tell them something about the Conventions, it would be a most interesting sequel to the present Paper. He remembered seeing Mr. Cook at the Glasgow Convention in 1905, and had the privilege of showing Mr. Cook and other members something about metallography. The British Foundrymen's Association was the first society that met in the Royal Technical College, Glasgow. Mr. Buchanan gave his second presidential address. An appendix giving a list of the Conventions and the names of the Presidents, in addition to the Secretaries, would be a useful addition to the Paper. Mr. Cook might also favour them with a list of the honorary members. He moved that a hearty vote of thanks be given to Mr. Cook for this Paper.

MR. R. A. MILES, in seconding the motion, remarked that some members of the Lancashire Branch had also interesting reminiscences.

MR. G. HALL said he was a member of the London Branch, and, while expressing on his own account his appreciation of the address, he would suggest to Mr. Faulkner that he should induce Mr. Cook to repeat it to the members of the London Branch.

MR. COOK said at one time there was trouble which looked like wrecking the Association, but it was grappled with. The first secretary was Mr. Finch; he was followed by Mr. Allbutt; then came Mr. Pilkington, junior. Those three were honorary secretaries. The fourth secretary, Mr. Hayes, had a certain amount given to him, but it was very small compared with the extent of the work done. A great deal of the success of the Institute was due to the work of those three honorary secretaries, and he did not know how they managed to get through that work. It had to be done at night, because they were engaged in business the whole of the day.

He had no hesitation in saying that the Institute was going to have a good time in the future. For some time past he had felt that propaganda work for getting in new members was lacking. In that respect there should be an improvement now, because they were on the right lines for getting such work done. That applied also to the men in the shops to which Mr. Haigh referred. It was a difficult matter, and he had given much time and thought to it. His conclusion was that they must try to get the foundry people when they were young; if they grew up with the Institute, they would not want to leave it. That great strides had been made since the Association was founded became apparent when one considered the state of knowledge in the foundry trade at that time. To the foundryman then pig-iron was pig-iron, and cast iron was cast iron; he did not trouble himself about the elements in it. In order to enlighten the people in the industry somewhat a glossary of terms was published. He did not think any association of an educational character in this country could claim to have progressed in its educational work to the same degree as the I.B.F.

Wasters in the Production of Aluminium-Alloy Castings in Permanent Moulds.

By Robert J. Anderson.*

(*Continued from page* 124.)

Speed of Operation.

Permanent-mould casting is a production proposition, and in American practice the moulders are often paid on a piece-rate basis. The speed of operation of a mould bears an intimate relation to the waster loss. If castings are allowed to remain too long in the mould after pouring and before the cores are drawn, difficulty may be had in extracting the casting. If removed too soon after pouring, cracks, breaks, and similar defects may occur. If the operation is too fast, the mould may become too hot, while if too slow, it will become too cold. The proper speed of operation for a given mould is readily worked out by a good moulder so that maximum production with a minimum of wasters is secured.

Operating Irregularities.

In practice numerous operating irregularities are encountered which not only reduce output but cause casting losses, and hence increase the cost of production. The chief operating irregularities have to do with the human element, control of the metallurgical practice, and peculiarities in the mould. A badly operating mould should be removed from the production floor and properly conditioned so that wasters are not attributable to some trouble with the mould itself. Frequent repair, overhauling, and conditioning of moulds and cores are important factors to good production and low waster loss. As a rule, all moulds in the plant should be given close inspection daily and minor repairs made promptly and when needed.

At the present time, mould and core temperatures must be controlled by the skill of the moulder and by speed of operation. A mould may get cold when minor repairing is required, and failure to pre-heat to the proper temperature results in wasters. Surface sinks are caused by cold mould walls. When minor repairs are made, the mould often becomes unconditioned as to temperature, and several castings may need to be poured before the mould is again operating satisfactorily. When a mould is working badly the moulder may "fight the mould," and rough handling of the mould and rocking of cores cause increased waster loss.

Metallurgical control of practice in the permanent-mould foundry should be adequate. Technical matters should be in charge of a competent metallurgist. Uniformity of composition in successive heats of the alloys is essential. This requires chemical analysis of all raw metals used, as well as of the finished castings, together with physical tests as needed. Individual moulds present operating irregularities which must be recognised. Two moulds may be made of the same size and design, yet one may tend to give good castings regularly while the other tends to give cracked castings. While there must be some definite reason for this variable behaviour of apparently identical moulds the causes are usually hard to determine.

In the plant of Aluminium Industries, Inc., Cincinnati, Ohio, an experimental mould room has been installed. This has been of great help in reducing wasters. When a new mould is delivered from the tool room it is sent to the experimental mould room for checking as to dimensions. The mould is then operated in the experimental room purely as a trial proposition until any difficulties with the mould are worked out. After the mould is operating satisfactorily in the experimental room, it is sent to the production line-up in the main shop. Previously, moulds were sent directly from the tool room to the production floor. If difficulty was experienced with the mould, the troubles had to be worked out in connection with the regular production. This had a bad psychological effect on the moulders, and scrap losses in the regular production tended to be higher. At the present time, when a mould works badly in the production line-up, it is removed to the experimental room and the troubles solved.

Systematic inspection of the castings produced in the permanent-mould foundry is essential in order to determine the causes for wasters and to take steps to prevent the occurrence of particular defects in future production.

Specific Defects Occurring in Permanent-Mould Castings.

The chief defects occurring in aluminium-alloy permanent-mould castings include the following:—Cracks, blowholes and porosity, inclusions and hard spots, draws and shrinkage cavities, air traps, rough surfaces, overlaps, metal shots, cold shuts, breaks and tears, warped and off-size castings, split seams, surface checks, water traps, and fins and flash These defects, their causes, and methods of prevention are discussed *in seriatim* below:

Cracks.

Cracks constitute a serious and common defect in the production of aluminium-alloy permanent-mould castings. The greater part of the wasters incurred in the average foundry is due to cracking. Cracks are traceable to the composition of the alloy (alloys with high contraction in volume on freezing tend to crack more readily than those

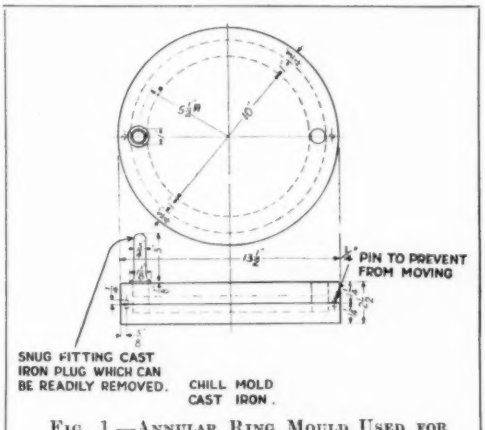

FIG. 1.—ANNULAR RING MOULD USED FOR TESTING CASTING PROPERTIES OF ALLOYS.

with low contraction), to too high pouring temperature, design of the casting (cracks tend to occur at the juncture of thin and thick sections which are not filleted), to wrong temperature of mould or cores, to hanging in the mould, and certain other factors In the operation of moulds, cores must be extracted at the right interval of time after pouring the casting; if left too long cracking will ensue, or the casting will stick to the cores, or both; if pulled too soon the casting may bleed, or at least crack and be damaged owing to its hot shortness at the high temperature. In the permanent-mould process, with liquid metal solidifying around a non-yielding core, the casting is stressed the more the longer it remains in the mould. Hence, the sooner that cores can be removed after freezing of the metal, the better. In general, most castings can be handled without breakage as soon as the pipe in the gate has stopped sinking. The time period during which aluminium alloys are hot-short is considerably shorter in permanent-mould casting

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than in sand casting; this is due to the more rapid chilling in permanent moulds. Hair-line cracks not visible on hot inspection may open up and be readily apparent when castings are examined cold.

Tests have been devised by the writer for determining the cracking tendencies of aluminium alloys when cast in chill moulds. Thus Fig. 1 shows an annular ring mould made of cast iron. Alloys for test may be poured into this mould, and the cracking tendency observed. The internal stress set up on pouring at different temperatures into such a mould heated to various temperatures can also be determined by the usual methods of cutting the cast ring and measuring the amount of movement of the freed ends. This test mould has been found very useful in practice. Fig. 2 shows an intergranular crack in 92: 8 aluminium-copper alloy poured in this mould at a high temperature. Fig. 3 shows another form of test mould used for determining the cracking and drawing tendencies of aluminium alloys at the juncture of thin and thick sections. The factors affecting the occurrence of cracks in aluminium-alloy sand castings have been previously discussed by the writer.[6]

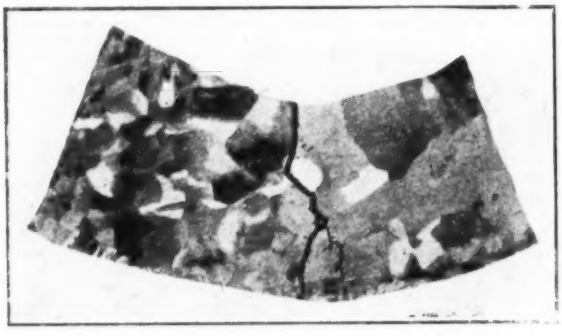

FIG. 2.—INTERCRYSTALLINE CRACK IN 92:8 AL-CU ALLOY POURED IN THE MOULD SHOWN IN FIG. 1 AT HIGH TEMPERATURE.

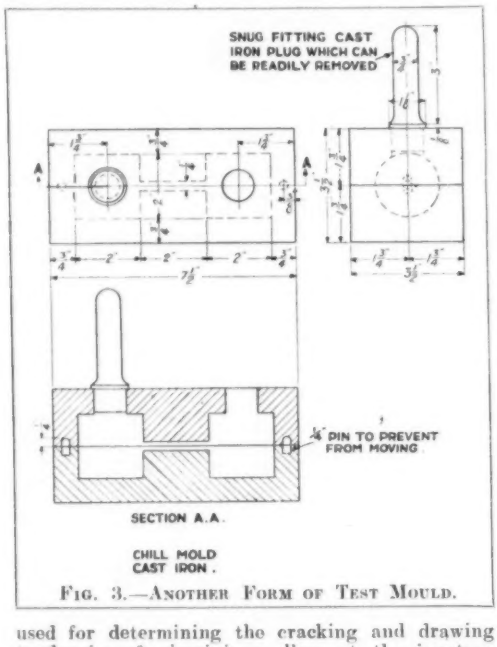

FIG. 3.—ANOTHER FORM OF TEST MOULD.

Blowholes and Porosity.

The occurrence of blowholes and porosity in aluminium-alloy permanent-mould castings is less likely than with sand castings. Relatively great soundness is an inherent feature of properly made aluminium-alloy permanent-mould castings. X-ray examination by the writer[7] has shown that permanent-mould castings are normally uniformly sound throughout, as contrasted with air-pressure die castings which contain large shrinkage holes beneath the sound surface skin, and sand castings which generally exhibit a more or less porous condition. Permanent-mould castings may contain isolated blowholes as well as minute porosity, but such defects are traceable to incorrect gating, gassed metal, or other factors which can normally be controlled. At the same time, such defects do occur in commercial castings. Soundness in castings is, of course, desirable in order to avoid the use of larger sections to compensate for porosity. The well-known pinholing defect which is usually associated with sand castings is ascribable to the escape of dissolved gas on solidification and the fact that the relatively slow solidification which occurs in a sand mould favours the occurrence of this defect. Experience and various experiments, *e.g.*, those of Archbutt,[8] have shown that if solidification is sufficiently rapid, as in a chill mould, the dissolved gases in aluminium alloys are not liberated but retained in the frozen alloy. On the other hand, if solidification is very slow, as on cooling a melt in the furnace, the gas is liberated and escapes from the melt. At some intermediate rate of freezing, as in a sand mould, the gases are liberated from solution but become entrapped in the solidifying alloy in the form of minute bubbles giving rise to porosity (the pinholing defect). Polished macrosections clearly show the relative soundness of permanent-mould and sand castings.

Briefly stated, blowholes and porosity are traceable to gassing of the alloy and are due directly to too-high melting and pouring temperatures, and too-slow solidification rates. Too-hot moulds are a cause of porosity in permanent-mould practice, since hot moulds inhibit rapid cooling and hence may permit the escape of dissolved gas which will be entrapped as minute bubbles. Localised porosity is also traceable to the gating and to too hot cores (the latter often giving rise to spongy spots). The general causes of blowholes and porosity in aluminium-alloy sand castings have been discussed by the writer[9] in another place.

At the permanent-mould plant of Aluminium Industries, Inc., Cincinnati, Ohio, work is being done to develop an X-ray fluorscopic method for the routine inspection of all castings for porosity, blowholes, and general unsoundness. This appears to be very promising.

Hard Spots and Inclusions.

Hard spots and other inclusions in aluminium-alloy castings are generally traceable to the melting practice. The occurrence of these defects can be readily eliminated by paying careful attention to the character of the raw materials charged into the melting furnaces. Too much emphasis cannot be laid on the necessity for cleanliness in melting. The question of hard spots and other inclusions has been previously discussed by the writer[10] as regards sand castings in aluminium alloys, and the general conclusions drawn apply also to permanent-mould castings. Inclusions, particularly hard spots, normally are discovered on machining. The machine-shop scrap properly ascribable to inclusions and chargeable to the

[6] R. J. Anderson, Cracks in aluminium-alloy castings, Trans. Amer. Inst. of Min. and Met. Engrs., vol. 68, 1922, pp. 833-860.

[7] R. J. Anderson, X-ray examination of aluminium-alloy castings for internal defects, Trans. Amer. Foundrymen's Assoc., vol. 33, 1926, pp. 261-279.

[8] S. L. Archbutt, A method of improving the properties of aluminium-alloy castings, Jour. Inst. of Metals, vol. 34, 1925, pp. 227-239.

[9] R. J. Anderson, Blowholes, porosity, and unsoundness in aluminium-alloy castings, U.S. Bureau of Mines Tech. paper 241, November, 1919, 34 pp.

[10] R. J. Anderson, Inclusions in aluminium-alloy sand castings, U.S. Bureau of Mines Tech. paper 290, June, 1922, 25 pp.

foundry should not be more than 0.5 per cent. Fig. 4 shows inclusions in an aluminium-alloy piston, found after machining. This example is a very bad case, seldom encountered in good practice.

Draws and Shrinkage Holes.

Draws and shrinkage cavities, which may be either internal or external, are directly traceable to the high-solidification contraction of aluminium alloys and the lack of suitable feeding. These defects are often difficult to eliminate and may require risers, chills, additional venting, enlargement of gates and feeders, and even re-design of the entire mould. High pouring temperatures favour the formation of shrinkage cavities due to the increase in the liquid contraction with increasing pouring temperatures. Hence, the occurrence of draws may often be eliminated by increasing the temperature of the mould and decreasing the pouring temperature. If the casting is properly fed, draws will not occur, but in permanent moulds it is often very difficult to arrange the feeding as desired. Surface sinks may occur on permanent-mould castings due to too hot mould walls which keep the metal liquid for too long a time. Internal shrinks may occur because of too cold moulds; in this case, the metal freezes too rapidly against the walls, feeding is prevented, and the shrinkage cavities form.

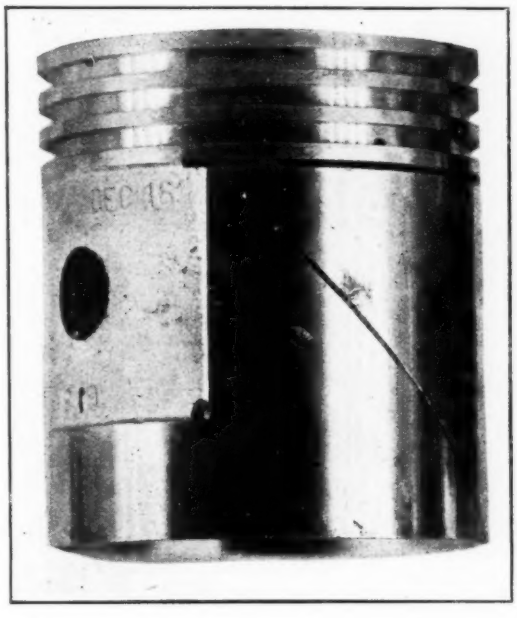

FIG. 4.—A BAD CASE OF A DEFECT THROUGH INCLUSIONS.

Air Traps.

Air traps may often be confused with sinks or cold shuts, but the former are due to lack of proper venting, hard pouring, and the entrapping of air by the flow of alloy in the mould. Air traps are usually readily eliminated by proper pouring, gating and venting. Parting lines are advantageous in preventing air traps, and extra partings may be provided in the mould; these extra partings should be permanently fixed by bolting the mould pieces firmly together.

Rough Surfaces.

Rough surfaces may be due to the condition of the mould walls and cores, and this defect may also be associated with unclean moulds and cores, poor dressing of moulds, metal flash pieces dropping into the moulds, minute air and water traps, as well as surface draws. Rough surfaces are readily eliminated by proper attention to details. Fig. 5 shows a rough bottom on a piston casting.

Overlaps.

Overlaps are due to turbulence of the liquid metal in its flow in the mould and are associated with the method of gating, speed of pouring, rate of flow in the mould and other factors. Shrink pads are useful in equalising rate of flow in the mould. Overlaps are shown as meeting lines of the liquid alloy as it has joined from different directions or lapped over in its flow, particularly when cold metal meets hotter metal.

Metal Shots.

Metal shots are due to breaking up of the liquid alloy on pouring and are caused by too steep gates or too fast pouring. If the metal is slopped into the mould so that it splashes, small pieces or shots may solidify and be found in the frozen casting as separate globules. This defect is easily remedied.

FIG. 5.—ROUGH SURFACE OF PISTON CASTING BOTTOM.

Cold Shuts.

Cold shutting and lack of proper filling are traceable to a number of factors including incorrect gating, cold moulds or cores, too low pouring temperature, lack of venting, lack of shrink pads, and too slow rate of pouring. The trouble can generally be corrected without much difficulty. Cold shuts may often be found in thin sections of castings during the time when a mould is being conditioned for production. Equalisation of flow is important in eliminating cold shuts, and this difficulty can often be corrected by altering the size and shape of feeders and shrink pads to direct liquid alloy to weak- and slow-filling portions of a mould.

Breaks and Tears.

Breaks and tears are usually due to lack of draft in the mould or cores, rough handling of the mould, cores and castings, pulling of cores and castings when too hot or too cold, and rocking of the cores and casting on removal. Castings may stick to the moulds and cores due to wrong composition of the alloy, bad condition of the mould or cores, and, on removal, breaks, tears and cracks occur. Exceptionally hot short alloys, like the zinc-bearing aluminium alloys, give more breakage than alloys not so hot short. Too fast operation of moulds is conducive to breakage. If small chips or pieces are broken out of cores, slight tears may occur in the casting when the cores are pulled. Both moulds and cores should be kept in good condition to avoid minor tears and breakages.

Warped and Off-size Castings.

Warped castings are due largely to too fast removal from the moulds, with consequently rapid cooling. Warpage may be very minor. Slight distortions are caused by the solid contraction of the alloy, which, as previously indicated, is difficult to overcome. Off-size castings are traceable to mould design and gating, allowing the cast-

ings to remain in the mould for too long or too short periods of time after pouring, the composition of the alloy, condition of the mould and cores, and the solid contraction of the alloy. Castings can be produced to fairly close size tolerance, *e.g.*, $\pm \frac{1}{64}$ in., but if precision limits are attempted, it is exceedingly difficult, and in many cases impossible, to prevent the occurrence of a high percentage of off-sizes. Most of the factors affecting off-sizes can be readily controlled, provided too close limits are not specified.

Split Seams.

Rough and split seams (at the parting line, or, in the case of multiple core sections, at the junctions of such sections) are due to badly made moulds or cores, lack of proper repair of moulds or cores, failure to properly set cores, or failure to properly lock the mould. This defect can be readily eliminated.

Surface Checks.

Surface checks in castings are, of course, due to surface checks in the mould walls or core faces, which in turn are caused by thermal fatigue, giving checked and cracked surfaces. When surface checks become bad, renewal of the checked part of the mould or core is indicated.

Water Traps.—Water traps (steam traps) are due to failure to shake off water on quenching cores.

Fins and Flash.—Poor-fitting mould halves, improper locking of moulds, poor-fitting core sections, and failure to properly seat cores, are the causes of excessive fins and flash. These defects are of little consequence in some castings, but in others, and when they occur at certain places, they may cause rejection of the casting.

Casting Losses in the Production of Aluminium-Alloy Permanent-Mould Castings.

The actual casting losses encountered in the permanent-mould casting practice vary, depending upon the various factors discussed above. Given a casting suitable for the permanent-mould process, a properly designed mould, and a good alloy, the most important factors affecting scrap losses are conditioning of moulds, metallurgical control, and ability of the moulders. The various factors affecting casting losses in the production of aluminium-alloy sand castings have already been discussed by the writer.[11] The general discussion given as regards sand castings applies also to the permanent-mould process, due regard being paid to the peculiarities of the latter. Whether castings are poured in sand or permanent moulds, scrap losses run up the cost of production and must be kept down to a reasonable figure or a plant cannot operate.

Wasters may be classed roughly into (1) scrap properly charged to the moulder, and (2) scrap ascribable to other causes over which the moulder has no control. Scrap properly charged to the moulder includes wasters due to cold moulds (unfilled or cold shut castings), off-size castings (due to warped or bent cores), breakage (due to too fast operation, rough handling, or fighting the mould), and wasters due to improper pouring and too hot or too cold moulds or cores. Regarding operating temperatures, the moulder is supposed to maintain his mould at the proper temperature and to regulate the core temperatures according to that of the mould. Speed of operation is very important in regulating mould temperatures. At the plant of Aluminium Industries the desired speed of operation for various castings is worked out first in the experimental mould room, and the moulder instructed accordingly. The moulder is charged with promptly reporting any trouble with a mould and with advising as to the condition of the mould and cores. As soon as a mould becomes out of condition or the core pieces warped or bent, prompt repair should be effected. If a mould or cores require repair during a run of castings, the mould may become unconditioned as to temperature, *i.e.*, too hot if burners are put on or too cold if allowed to stand.

The inspection of castings is very important, and lax inspection will increase the ultimate loss and mean much trouble with purchasers. At the plant of Aluminium Industries, the moulder inspects each casting casually as he removes it from the mould for any gross defects. Then the moulder's production is inspected closely while hot by so-called hot inspectors, who examine rigidly for cracks, draws, slight cold shuts, and other surface defects not readily visible to the moulder. If defects are occurring, the hot inspector promptly notifies the moulder and the foremen, and steps are taken immediately to correct the trouble. Hot castings from each run are cooled off in the air and given a machining test in the foundry, with examination for internal porosity, blowholes, hard spots, shrinks, and other defects. After the castings which have been inspected hot are cut off as to gates and dressed on the grinder, they are given a minute inspection cold for surface defects. Dental mirrors are used for looking into recesses and undercuts, and magnifying glasses for hairline cracks. Certain classes of castings require only casual inspection for surface appearance, but it generally pays to make close inspection of the entire output.

Very complete records have been gathered by the writer covering casting losses in the production of a wide variety of permanent-mould castings. The total loss in production, including machining scrap, should not exceed 5 per cent. of the castings poured, with proper control and operation. Actual losses in a variety of castings have run from 3 to 30 per cent., with an indicated average of about 8 per cent. A few recorded cases of waster-loss records are given below.

In the case of a small difficult casting where the mould was operating badly, the total number of castings poured was 475; number of good castings was 329; scrap thrown out by the moulder was 28 castings, or about 6 per cent.; scrap thrown out by the hot inspector was 53 castings or about 11 per cent.; scrap thrown out by the cold inspector was 65 castings, or about 14 per cent.; and total waster loss was 146 castings, or about 31 per cent. This is a very high loss.

In the case of another casting where the operation was considerably better than in the above, the total number of castings poured was 5,420; number of good castings was 4,833; scrap thrown out by the moulder was 161 castings, or about 3 per cent.; scrap thrown out by the hot inspector was 254 castings, or about 5 per cent.; scrap thrown out by the cold inspector was 172 castings, or about 3 per cent.; and total waster loss was 587 castings, or about 11 per cent.

In another case with a small and simple casting, the total number poured was 214; number of good castings was 209; no scrap was thrown out by the moulder or hot inspector; and the total waster loss was 5 castings, these being rejected by the cold inspector. The total loss was thus 2.4 per cent.

In another case the total number of castings poured was 363, of which 349 were good. No scrap was thrown out by the moulder, while the number of castings thrown out by the hot inspector was 3, or under 1 per cent., and that thrown out by the cold inspector was 11, or about 3 per cent. The total waster loss was 11 castings, or about 4 per cent.

In still another case, 3,562 castings were poured, of which 3,328 were good. The moulder threw out 104 castings as scrap, or about 3 per cent.; 85 were thrown out by the hot inspector, or about 2 per cent.; and 45 were rejected by the cold inspector, or about 1 per cent. The total loss was 234 castings, or about 6 per cent.

In a short run 59 castings were poured, of which all were good except one, which was thrown out by the moulder and was cracked due to rocking of a core section on dissembling the mould.

With another short run 40 castings were poured, and 37 were good. Of the three defective castings, one was cracked due to core rocking, and two contained shrinks due to cold cores. The three defectives were thrown out by the moulder. On a long run of about 200,000 castings, about 184,000 were good, and the total scrap loss was about 16,000, or 8 per cent.

[11] R. J. Anderson, Casting losses in aluminium-foundry practice, Trans. Amer. Foundrymen's Assoc., vol. 29, 1921, pp. 459-487.

Institute of British Foundrymen.

THE ANNUAL DINNER OF THE LANCASHIRE BRANCH.

The annual dinner held at the Grand Hotel, Manchester, was presided over by Mr. S. H. Smith. Amongst the guests were Mr. V. C. Faulkner, President of the Institute; Sir Benjamin Longbottom, the President of the Manchester Association of Engineers; and Mr. Oliver Stubbs, M.I.Mech.E., Past-President of the Institute.

Advantage of Local Centres.

After the toast of "The King," had been proposed by the CHAIRMAN, and duly honoured, SIR BENJAMIN LONGBOTTOM proposed the toast of "The Institute of British Foundrymen." He said after he had received particulars regarding the Institute he realised that foundrymen were in a way a race apart, distinguished from others by their ability to determine what they wanted, go for it and get it. This was shown by the record of their achievements, which embraced the formation of the Institute itself and the creation of some 13 local centres, a Junior Section, a Research Association, International Conventions. It was a natural and logical sequel that the Institute should obtain a Royal Charter before it attained manhood. The members deserved it because they had worked for it, and those gentlemen who originally constituted the Central Council—of whom some were present that evening—had every reason to be proud of the success which had been achieved. It was brought about by the active work of the members in the local centres. As a member of the Institution of Electrical Engineers and of the Institution of Mechanical Engineers, he knew that when those great Institutions created their local centres they acquired a new lease of life. However effective a Central Council might be, or would like to be, they could not progress and go ahead unless material was supplied by the local centres. The record of the Institute since 1904 was a magnificent one, and had made the ironfounding industry a different proposition from what it was in the old days. During the last two months the papers had declared that the recovery of trade was with them. Personally he had failed to see it yet, but he deeply hoped for it, and he was satisfied that when it did come the engineering industry would get full support from those engaged in the foundry industry. No doubt foundrymen would realise the straits of the engineers and be moderate in their prices and give excellent service.

Importance of Textile Machinery.

MR. V. C. FAULKNER, responding to the toast, said this year, 1927, was the 25th anniversary of the establishment of THE FOUNDRY TRADE JOURNAL, and the early history of an Institution so closely connected with it as the I.B.F. had been was of particular interest. For that reason Mr. Cook's address that afternoon had interested him very much.

For some little time past there had been a discussion in the Press as to which was the centre of the foundry industry in Great Britain. It was a difficult question to decide. If one took merely the total number of foundries he believed London would have it. But the number was swollen by foundries of mushroom growth and of small capacity. Taking the number of moulders employed, and the value of output, he thought Manchester would come first. An examination of the Board of Trade statistics showed very definitely that the largest section of the machinery exports from this country was textile machinery, which was largely made in the Manchester district, and was an aggregation of castings. He was rather surprised to hear Sir Benjamin Longbottom say that he had not yet felt the effect of improved trade, because he understood Sir Benjamin was connected with the electrical machinery industry, and yet statistics showed there had been very considerabde exports. In fact, in the international market, the British electrical machinery industry now led, which it did not do so before the war. In Birmingham a fortnight ago he said trade must be improving because the list of contracts for foundry work was the largest he had seen for the last six years. That list had been maintained, and was now still larger.

Reference had been made to the international activities of the Institute. Foundrymen were particularly partial to that. Speaking now on behalf of his friend, Mr. Ropsey, the President of the Belgian Association, he could tell his hearers that M. Ropsy would be very pleased to see any of them at Brussels on March 19 for their annual conference. On that occasion an international committee would assemble and discuss the arrangements for future International Congresses. He was glad, also, to be able to announce that there would be an International Congress in England in 1929, probably in London. It was hoped that British foundrymen would do their best to maintain the already high standard set by the Americans and the French. They should begin their preparations immediately, so as to make sure of achieving in that year something equal to if not superior to what had been done in the past. He thought the time had arrived when they would be justified in the near future in asking permission to nominate a prominent foundryman in the Dominions to be their resident honorary corresponding secretary; he would become more closely identified with the Institute, and would be able to push propaganda on its behalf successfully.

The Guests.

MR. OLIVER STUBBS proposed the toast of "Our Guests." Giving the first place to the ladies he remarked that after seeing that afternoon the nature of their deliberations, no doubt they would recognise what a splendid organisation the Institute was and never grumble at a husband being detained when he could plead that he had been on business connected with it. They were very pleased to have with them Sir Benjamin Longbottom, who had the honour of presiding at the World Power Conference at Wembley. A second prominent guest was Mr. F. J. Cook, a Past-President, who took a very great interest in the Institute, and the same could be said of another Past-President, Mr. John Cameron, whom they had expected to see, but who was unable to come, and in his absence Mr. George Hall, a member of the London Branch, would reply to the toast.

MRS. JOLLEY, responding to the toast, said she understood at the annual dinners of some of the Branches ladies were not present. The Lancashire Branch was to be congratulated on being much more progressive. Ladies heard a good deal about the Institute, they took a strong interest in its work, and were helpful in their way. Unless they were willing to forego the company of their husbands, occasionally, the work of the Institute would be impeded.

MR. G. HALL said the attempt to persuade the London Branch to include ladies in its annual social function had hitherto failed, but perhaps the members would change their views when they had heard more about the Lancashire Branch. On behalf of his fellow guests he cordially thanked them for their hospitality.

Lancashire Branch.

MR. F. J. COOK proposed the toast of "The Lancashire Branch." He said a survey of the history of the Institute showed that it had attracted men who had the highest ideals, who were perhaps best described by the term "entire gentlemen." The East Midlands Branch had Mr. Sidney Gimson and Mr. S. H. Russell. Birmingham would always remember with pride Robert Buchanan and Professor Turner. The Lancashire Branch had been singularly fortunate in the number of men of this type who had served it. There were, for instance, Mr. W. H. Sherburn and Mr. R. W. Kenyon. Another man who had always impressed him was the chairman of the evening, Mr. Smith—(applause)—who had great influence with young men attending classes in Manchester. He was sure Mr. Smith had impressed his students with the same ideals.

The CHAIRMAN said the Lancashire members were proud of their Branch. It had a good record. There were still amongst them some who actively

assisted in the formation of the Association in 1904. It was also a source of pride that their esteemed Mr. Oliver Stubbs had filled the presidential chair of the Institute on two occasions, and was responsible for the institution and financing of the gold medal award of merit to which the name of the "Oliver Stubbs Gold Medal" had been given. Mr. Cook was the first recipient of that medal, and well he deserved it. (Applause.) The Lancashire Branch Junior Section numbered now 170 members, and while it was in existence they need have no anxiety regarding the future. The Branch had also under its wing the Burnley Section, which was doing good work.

Presentation to Mr. T. Makemson.

The toasts were followed by the presentation to Mr. T. Makemson of a bookcase and dressing-case, inscribed, "As a mark of esteem from the members of the Institute for services rendered as hon. secretary of the Lancashire Branch from May, 1922, to December, 1926." The presentation was made by Mr. R. A. Miles, who also gave to Mr. Makemson a list of the subscribers, totalling 110 names. MR. MILES said the Branch had been very fortunate in having his services: the members deeply regretted that he was leaving them, but they recognised that it was for the good of the Institute which would benefit from Mr. Makemson's activities as general secretary. They had readily responded to the request to show their appreciation in tangible form and contributions had been received from other parts of the country.

MR. MAKEMSON said he was not at all sure he deserved the kindly things said about him, but it was very satisfactory to know that Mr. Miles and others had the feelings which were so expressed. The members had been uniformly kind and helpful, and had made pleasant what otherwise would have been difficult work. When he began his duties the Branch had had a very successful time under his predecessor, Mr. Hogg, and he must thank that gentleman for initiating him into the work and putting everything into order so that he was able to go straight ahead. If he had in some measure succeeded in his office it was sufficient thanks for anything he had done, and he hoped the members would support his successor, Mr. H. Stead, in the same way. He must acknowledge the admirable way in which Mr. C. F. Brereton, the assistant hon. secretary, had carried on the work practically single-handed for a time.

Presentation of Diplomas.

The CHAIRMAN announced that two diplomas had been awarded. One was given to Mr. A. J. Richman in recognition of the excellence of his Paper on "The Production of Diesel Engine Castings in Pearlitic Cast Iron," read before the Lancashire Branch during the session 1925-26. The other was given to Mr. Walter West in recognition of the quality of his Paper on "Oil Sand and Production," read before the Burnley Section during the session 1925-26. Unfortunately both those gentlemen were unable to be present. Mr. J. S. G. Primrose would receive the diploma on behalf of Mr. Richman, and Mr. Hogg would act for Mr. West, who was indisposed.

MR. FAULKNER made the presentation. He said he regretted that he did not know Mr. Richman personally, but he had followed with a large amount of satisfaction the work that Mr. Richman had carried out. His researches were such as must commend themselves to the metallurgical sections of the Institute, and the Paper which secured him the diploma dealt with a peculiarly controversial subject. It was of a most interesting character, and had been followed carefully by leaders of thought in the foundry industry.

Mr. West he regarded as one of the best members of the Institute. He could deal with academic subjects in such a way that the ordinary foundryman could understand them. Regarded from that standpoint the Paper on sands which he gave before the West Riding of Yorkshire Branch several years ago was probably the best contribution on that subject which had been read before the Institute. He would ask Mr. Hogg to convey to Mr. West their earnest wishes for his speedy return to normal health.

MR. PRIMROSE briefly replied, thanking Mr. Faulkner for his kindly references to Mr. Richman. MR. HOGG replied in similar strain. He added that in Burnley they were very proud of their section. It had made the Institute known to everybody in the district. The head of the Technical College, the head of the Engineering Department and the Education Committee were all keenly interested in it, and a sub-committee had been appointed with a view to installing a cupola in the College. (Applause.) When Mr. A. Henderson, M.P., made a speech at the Conference in London it was fully reported in the Burnley paper, and the editor stated in an editorial paragraph that he was very proud they had in Burnley a branch of so excellent an institution.

A musical programme was rendered by Miss Christina Struggles, Mr. G. H. Blair, and Mr. H. Gilmour. The accompanists were Miss E. Jowett and Miss D. J. Key.

Welding Manganese-Steel Castings.

The fact that some of the desired properties of manganese steel are the result of heat treatment makes the welding problem a difficult one. Added to this is the fact that the high temperatures involved in welding also tend to change the chemical and physical nature of the steel slightly. Though a second heat treatment will restore the original properties in the main casting, it is sometimes difficult to correct structural changes in the narrow zone at the juncture of the weld metal and the basis metal.

Though it is considered that the welding of manganese steel is not yet fully developed, and though experimental work is still being done on this metal, certain practices have given satisfactory results. It is obvious that smaller castings will respond more satisfactorily to welding and subsequent heat treatment under ordinary shop conditions than larger and bulkier castings, because it is easier to heat uniformly and quench rapidly the smaller castings than those of greater bulk.

To prepare a casting for welding, the edges should be bevelled to a 90-deg. total vee. This work can be done only by grinding or by cutting with the oxy-acetylene torch. If the latter method is used, it is recommended that the edges be ground or pickled to remove adhering oxide.

Welding should be preceded by pre-heating, handled in about the same way as common cast iron. Larger castings should be heated slowly in a charcoal-fired pre-heating furnace of bricks; for small castings a petrol pre-heating burner or even the welding torch can be used. Manganese steel is quite brittle when red hot, so castings should be carefully supported during pre-heating and welding. Castings should be welded in the pre-heating furnace and protected from drafts or other sources of sudden chilling while hot.

Special manganese steel-welding rods should be used. The flame of the torch should be adjusted to show a slight excess of acetylene. Some very satisfactory work has been carried on with an excess-acetylene flame showing an excess cone about three times as long as the inner cone.

It is essential that a comparatively large tip or welding head be used and that a large pool of melted metal be maintained at all times. The welding rod must not be rubbed in the weld, but must be held under the surface of the molten pool and the flame applied to melt the rod in the pool of molten metal. When the level of the pool is high enough, it can be melted into the basis metal by directing the flame around the edges until the weld metal and the basis metal flow together through their own fluidity. Avoid, however, getting such a big pool that it spills over on the solid metal.

After welding is completed, the entire casting should be reheated to a bright yellow-red, or about 1,250 deg. Fah., maintained at this temperature for about 30 min., and then quenched in tepid water. It has been found that by far the best results are obtained by dropping the entire casting in a large vessel of water. It is not sufficient simply to pour water on the heated metal. A sound weld made under these conditions will give satisfactory results where an unusual amount of strength in the welded part is not required.—"Engineering and Mining Journal."

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Trade Talk.

IT IS UNDERSTOOD that Martin & Company, of Calcutta and London, will shortly acquire a controlling interest in Burn & Company, of Calcutta.

THE INTERNATIONAL LABOUR OFFICE of the League of Nations is being removed from 26, Buckingham Gate, S.W.1, to 12, Victoria Street, London, S.W.1.

WILLIAM HARPER, SON & COMPANY, Star Foundry, Birmingham Street, Willenhall, announce that the title of the firm has been altered to William Harper, Son & Company (Willenhall), Limited.

THE DILLINGEN COMPANY, in the Saar district, announces that, owing to the present depression in the trade, only two shifts will be worked until further notice at its basic Bessemer steel plant and cogging mill. Some 250 workers have been discharged.

HARLAND & WOLFF, LIMITED, have secured a contract for two oil tankers of about 2,300 tons deadweight for the Anglo-Saxon Petroleum Company. The two vessels will be steam-driven, and both the hulls and machinery will be constructed at the firm's Belfast works.

THE TONNAGE ALLOTMENTS of countries adhering to the Steel Rail Cartel is fixed as follows: Great Britain, 43 per cent. (including the tonnage to be ceded by Great Britain to the United States); Germany and France, 19½ per cent. each; Belgium, 11 per cent.; Luxemburg, 7 per cent.; Czecho-Slovakia, 4 per cent. The total tonnage to be exported is said to be fixed at one million tons.

THE ESTONIAN GOVERNMENT placed an order with British manufacturers last year for the supply of about 15,000 tons of permanent way materials, including light and heavy rails. Owing to the coal strike the order could not be executed, but now the work is being put in hand, and deliveries will commence shortly. The contracts were given to William Beardmore & Company, Limited, of Glasgow, and Becos Traders, Limited, of London.

A MEETING ARRANGED JOINTLY by the Library Association (London and Home Counties Branch) and the Association of Special Libraries and Information Bureaux, will be held on Wednesday, February 23, at the Royal Institute of British Architects, 9, Conduit Street, London, W.C.1. Mr. G. F. Barwick, late Keeper of Printed Books at the British Museum, will give an address on the "Directory of Sources of Specialised Information" that is now being compiled by him for the Association of Special Libraries and Information Bureaux. Prior to the address there will be an informal discussion on "Public and Special Libraries: Their Spheres of Service and Potential Relationship," which will be opened by Mr. J. D. Stewart, Borough Librarian of Bermondsey, and Mr. J. G. Pearce, Director of the British Cast Iron Research Association and chairman of the council of A.S.L.I.B.

IN THE FACE OF KEEN COMPETITION from Continental shipbuilders, British firms have secured orders for six vessels of a total value of £1,000,000. Three will be oil tank vessels to carry 15,000 tons dead weight, and are to be built by the Furness Shipbuilding Company, Limited, Haverton-hill-on-Tees. They are to be constructed on the Isherwood system, and fitted with Doxford-Diesel engines by Richardsons, Westgarth & Company, Limited, Hartlepool. The other three vessels will be twin-screw oil tank steamers of about 3,700 tons dead weight each. They are to be built by Palmers Shipbuilding and Iron Company, Limited, Jarrow-on-Tyne, also on the Isherwood system, and their machinery will be constructed by Richardsons, Westgarth & Company, Limited. The contracts were placed by Mr. G. H. Taber, vice-president of the Gulf Refining Company, of Pittsburgh, U.S.A., and the negotiations were carried out by Sir Joseph W. Isherwood, Bt., who will supervise construction.

THE BUSINESS of Gwynne's Engineering Company, Limited, Hammersmith Ironworks, London, W., makers of centrifugal pumps, etc., has been acquired by Wm. Foster & Company, of the Wellington Foundry, Lincoln, and the shareholders have been notified that the whole of the London firm, including a quantity of the highly specialised plant, will be transferred to Lincoln. The Hammersmith works will be dismantled, and the site, and such of the plant as is not removed to Lincoln, will be disposed of. Only the staff at Hammersmith will be transferred to Lincoln, and it is anticipated that eventually work will be found for between three and four hundred men locally. In order to preserve the goodwill of the firms, both Fosters and Gwynnes will continue to trade in their own names, and two directors of Gwynne's—Mr. Nevile G. Gwynne and Mr. Charles Armitage—will join the board of Messrs. Foster, of which Mr. C. W. Pennell is chairman and Sir William Tritton the managing director.

Personal.

MR. CHARLES M. SCHWAB, the American steel magnate, arrived in London on Friday last from New York.

MR. K. D. CAMPBELL, late sales manager of the Campbell Gas and Oil Engine Company, Halifax, has been appointed to a similar position with Petters (Ipswich), Limited.

FOLLOWING THE RECENT appointment of Sir Andrew Duncan as chairman of the Central Electricity Board, the Minister of Transport has announced the names of the seven members of the Board. They are: Sir James Devonshire, chairman and general manager, the North Metropolitan Electric Power Supply Company and allied companies; vice-president, Incorporated Association of Electric Power Companies. Mr. Frank Hodges, J.P., secretary, International Miners' Federation. Sir James Lithgow, Bt., ex-President of National Confederation of Employers' Organisations. Alderman W. Walker, vice-chairman, Manchester Corporation Electricity Department; chairman of National Joint Industrial Council for the Electricity Supply Industry, and chairman of National Joint Board of Electricity Supply Industry. Sir Duncan Watson, chairman of the London and Home Counties Joint Electricity Authority; chairman of the Conference of Joint Electricity Authorities, Joint Advisory Boards and Joint Committees. Mr. W. K. Whigham, director, Bank of England, and member of the Trade Facilities Act Advisory Committee. Brevet-Colonel the Hon. Vernon Willey, director, Lloyds Bank, late Controller of Wool Supplies, Ministry of Munitions, and ex-president of the Federation of British Industries.

Wills.

FELLOWS, J., of Compton Grange, Cradley Heath, Staffs, founder of the Clyde Works, Cradley Heath	£32,336
LEYLAND, C. J., of The Mead, Beal, a director of the Parsons Marine Steam Turbine Company, Limited	£2,221
SUTCLIFFE, S., Rhyl, Flint, managing director of the Darwen and Mostyn Iron Works Company, Limited	£81,921
WOODS, JOHN, of Woodbine Villa, Rainhill, Lancs, brassfounder, of J. & J. Woods, Limited	£35,156

Contracts Open.

Cardiff, February 18.—(2) 3-in., 4-in., 6-in., 7-in., 9-in. and 12-in. cast-iron pipes and special castings, to be delivered during the six months ending September 30, 1927, for the Corporation. Mr. N. J. Peters, water engineer, City Hall, Cardiff.

Chester-le-Street, February 19.—(7) Manhole covers, lamphole covers, street gullies, etc., for six months from March 1, for the Rural District Council. Mr. R. V. Dickinson, clerk, Union Offices, Chester-le-Street.

Dunfermline, February 22.—2,300 lineal yards of 6-in. cast-iron water pipe, etc., for the District Committee. Mr. H. F. Hodge, district engineer, County Buildings, Dunfermline. (Fee £2 2s., returnable.)

Erith, February 19.—Cast-iron goods during year ending March 31, 1928, for the Urban District Council. Mr. D. S. Twigg, clerk, Council Offices, Erith.

Hull, February 21.—Pipes and gullies, iron castings, iron and steel, for the Corporation. The City Engineer's Office, Hull.

Ilford, February 21.—(5) Iron castings; (11) iron, farriers' tools, nails, screws, etc., for 12 months ending March 31, 1928, for the Town Council. Mr. H. Shaw, M.I.C.E., engineer and surveyor, Town Hall, Ilford. (Fee 1s. for each form, non-returnable.)

London, S.E.6, February 24.—Iron castings for one year from April 1, for the Lewisham Borough Council. Surveyor's Department, the Town Hall, Catford.

London, S.W.1, February 22-March 1. — (1) Two engine turntables; and (2) girder bridges, comprising spans of 9 ft., 40 ft. and 41 ft. 9 in. clear, a total approximate tonnage of 216.7 tons, for the Madras and Southern Mahratta Railway Company, Limited, 25, Buckingham Palace Road, S.W.1. (Fee £1 1s. each.) Tenders due February 22 for (1) and March 1 for (2).

Swansea, February 19.—Iron and steel, pipes, tubes, manhole covers and frames, gullies and frames, lamp pillars, etc., for six months from April 1, for the Town Council. The Borough Engineer and Surveyor, Guildhall, Swansea.

Twickenham, February 23.—(10) Iron castings; (11) street gullies and drain pipes, for 12 months from April 1, for the Corporation. Mr. F. W. Pearce, borough engineer and surveyor, Town Hall, Twickenham.

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IRON AND STEEL MARKETS.

Pig-Iron.

MIDDLESBROUGH.—The Cleveland pig-iron trade position remains substantially unchanged. Makers are gradually overtaking arrears, but prompt iron is, nevertheless, still extremely difficult to obtain. Makers have full order books, but forward business has shown a sagging tendency, buyers being inclined to wait in the hope of better terms. Fuel costs, however, are the crux of the situation, for until coke is cheaper ironmasters have no great inducement to expand their outputs. On the other hand, coke production is now very nearly at full practicable capacity, for the majority of the ovens not yet lighted up require repairs or reconstruction, which would take many months to complete. Hence, producers are by no means inclined to make concessions, as the present demand is certainly greater than the supply. Failing, therefore, the importation of Continental coke, which is not at present apparently very probable, no substantial change in coke values seems to be likely. Neither can there be much hope of easier terms for pig-iron.

There has been no further increase in the production of East Coast hematite, and several works still remain idle pending lower fuel costs. Meanwhile all the hematite produced is going immediately into consumption. The tone in the market for West Coast iron is flat, one of the causes assigned for the continuing lull in trade being the uncertainty of the situation in the Far East. Whatever may be the reasons for the quietness at present prevailing, it is a fact that forward business is disappointingly small in extent, and that users are indisposed to enter into commitments that would enable makers to anticipate more confidently their ability to maintain production at the level now obtaining until the end of the first half of the year. There is, of course, a little booking for delivery in May and June, but the tonnage represented is not large, and smelters, with not much more than three months' work facing them, may be expected to observe caution in regard to the lighting of additional furnaces. As things stand, the furnace that it is hoped to put on to ferro-manganese at Old Side at Workington, in the first week in March, is the only one that it is probable will be relighted. The number in blast between Workington and Carnforth is fifteen, Cumberland claiming eight and North Lancashire the remaining seven.

LANCASHIRE.—Conditions in the pig-iron market have more or less resolved themselves into a price tussle between producers and consumers. The latter still seem determined to wait until they can get in at lower prices before they place orders for any important weight of business, while makers point to dear fuel and increased railway rates as factors which add considerably to their production costs compared with what they were before the strike. The second factor will, of course, continue to operate, but, with lower coke prices, there should be a margin for reducing quotations. In the meantime, from every quarter one hears complaints of the poor state of the current demand. Values keep steady in pretty well every section of the market, Staffordshire and Derbyshire foundry irons for delivery into the Manchester district being quoted at round 93s. per ton, with forge qualities at roughly 5s. per ton less than this figure.

THE MIDLANDS.—Foundry iron is now more plentiful, but the position will continue to become easier as the month progresses, as more furnaces are blowing in. At the present time it is possible to get various brands of Northamptonshire, Derbyshire and Staffordshire pig, and for the time being there is no indication of any lower prices being quoted, although it is the general opinion of consumers that low levels will be reached during next month.

SCOTLAND.—There is no improvement to report in the demand for Scotch pig-iron, but in spite of this five more blast furnaces will be in operation shortly, bringing the total up to 26, and this is more than were in operation when the strike broke out. At the moment there is not too much foundry iron available, and consequently prices are unchanged at from 90s. to 92s. 6d. for No. 3 foundry at the furnaces. Traders are disappointed at the slow recovery in business, but are still hoping that, as time goes on, the volume will grow. The sooner prices come down, the greater the volume of business that is likely to come out. The malleable works are finding new business very scarce, and, unless there is an improvement, they will soon be back to the condition of not being able to see sufficient work in their books to keep them going beyond 48 hours. For forge iron they are being asked to pay 91s. delivered.

Metals.

Copper.—The depression in standard cash copper noted for some time past has become intensified during the present week, warrant prices having broken into new low records not seen for about thirteen years. At the lower range much heavier dealings were noted, and the market steadied a trifle. One of the main depressing factors was the rather unexpected further sharp cut made in electrolytic by the export combine. Evidently the combine are determined to follow the continuous shading of prices on the part of outside sellers, who made fair sales to cablemakers for March arrival at £62 5s. Since, quotations for electrolytic have been further reduced outside of the combine, and this naturally aggravated the weakness of the market.

Official closing prices of standard copper have been as follow :—

Cash : Thursday, £54 5s. to £54 7s. 6d. ; Friday, £54 7s. 6d. to £54 10s. ; Monday, £54 10s. to £54 12s. 6d ; Tuesday, £54 10s. to £54 12s. 6d. ; Wednesday, £54 5s. to £54 7s. 6d.

Three Months : Thursday, £54 15s. to £54 17s. 6d., Friday, £54 17s. 6d. to £55 ; Monday, £55 2s. 6d. to £55 5s. ; Tuesday, £55 to £55 2s. 6d. ; Wednesday, £54 17s. 6d. to £55.

Tin.—Following the publication a few days ago of the monthly tin statistics, showing a decrease of 811 tons in the visible supply, values of standard again firmed up. The outlook for the metal appears to be quite good, as stocks here are limited, whilst deliveries in the United Kingdom during January amounted to 1,664 tons. Consumption in America is well maintained, and the chief tinplate producers there are well provided with orders, and if the expected expansion in business takes place in South Wales the supply position may become more strained. The latest estimate of February shipments from the Straits puts them at 4,250 tons, the recent floods in the mining districts being the cause of the curtailment. From April onward there may be some easing of the tension, owing to the increased number of dredgers which will be brought into operation in Malaya, and the results of these dredgers, which will be worked in greater depths, will be eagerly awaited.

Official closing prices of standard tin have been as under :—

Cash : Thursday, £308 to £308 5s. ; Friday, £308 15s. to £309 5s. ; Monday, £308 5s. to £308 10s. ; Tuesday, £304 to £304 5s. ; Wednesday, £305 5s. to £305 10s.

Three Months : Thursday, £295 15s. to £296 ; Friday, £294 15s. to £295 ; Monday, £294 15s. to £295 ; Tuesday, £293 to £293 5s. ; Wednesday, £295 to £295 5s.

Spelter.—Ordinary brands of spelter have been decidedly weak, and close near the worst in the absence of consumers' buying, due to freer offers from the Continent. Production has been on the increase again in Belgium, and stocks have been accumulating both on the Continent and also in the United States. The outlook can hardly be called promising, albeit the relatively low price should attract new buying.

The following are the week's prices :—

Ordinary : Thursday, £29 10s. ; Friday, £30 ; Monday, £30 7s. 6d. ; Tuesday, £30 ; Wednesday, £29 18s. 9d.

Lead.—Soft foreign lead has been generally weaker, although showing at one time a fair recovery from the worst. There is too much lead hanging on the market to expect any notable improvement for some time, and it looks as if efforts were being made by certain parties in order to keep down the price. Arrivals will probably turn out lighter.

Less than seventy years ago the United Kingdom produced about one-quarter of the world's total output of lead, and although the deposits are still known to exist, the industry has declined considerably and the yearly contribution has now fallen to a trifling amount.

The week's prices are appended :—

Soft foreign (prompt) : Thursday, £27 7s. 6d. ; Friday, £27 10s. ; Monday, £27 17s. 6d. ; Tuesday, £27 16s. 3d. ; Wednesday, £27 7s. 6d.

THE BRITISH STEELMAKERS, at their meeting last week, decided to make no change in prices, although they are faced with a very substantial and immediate increase in railway rates. This action has been taken with a view to doing everything within the power of the steelmakers to encourage home and foreign markets. By making no increase in prices the steelmakers are assuming to themselves the entire burden of the increase in railway rates, which the trade can ill-afford to bear.